Welcome to the Product Guide!

Cisco WLAN Solution 3.0: Last Updated May 26, 2005

The Product Guide describes the Cisco Wireless LAN Solution (Cisco WLAN Solution) products.

Refer to the *OVERVIEWS* section to see a big picture view of Cisco WLAN Solution products and features.

See the *SOLUTIONS* section to look through real-world network and application-specific solutions to real-world problems.

Go to the *TASKS* section to find detailed instructions on how to install, configure, use, and troubleshoot Cisco WLAN Solution products and supported 802.11 networks.

Visit the *REFERENCES* section to find technical information, such as the Glossary and Supported Country Codes and Regulatory Domains, as well as pointers to the CLI Reference, Web User Online Help files, Cisco WCS Online Help files, Cisco 1000 Series Lightweight Access Point Deployment Guide, Hardware and Software Quick Start Guides, the Cisco Wireless LAN Controller User Guides, and the current Release Notes.

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Legal Information

This section includes the following legal information:

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- *General Terms Applicable to the Limited Warranty Statement and End User License Agreement*
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The following describes the Cisco Systems, Inc. standard Product Warranty for End Customers.

Products

- Cisco 1000 Series Lightweight Access Points.
- Cisco 2000 Series Wireless LAN Controllers.
- Cisco 2700 Series Location Appliances.
- Cisco 4100 Series Wireless LAN Controllers.
- Cisco 4400 Series Wireless LAN Controllers.

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http://www.cisco.com

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http://www.cisco.com/public/countries_languages.shtml

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Cisco Systems
Attn: Customer Document Ordering
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Cisco Product Security Overview

Cisco provides a free online Security Vulnerability Policy portal at this URL:

http://www.cisco.com/en/US/products/products_security_vulnerability_policy.html

- From this site, you can perform these tasks:
- Report security vulnerabilities in Cisco products.
- Obtain assistance with security incidents that involve Cisco products.
- Register to receive security information from Cisco.

A current list of security advisories and notices for Cisco products is available at this URL:

http://www.cisco.com/go/psirt

If you prefer to see advisories and notices as they are updated in real time, you can access a Product Security Incident Response Team Really Simple Syndication (PSIRT RSS) feed from this URL:

http://www.cisco.com/en/US/products/products_psirt_rss_feed.html

Reporting Security Problems in Cisco Products

Cisco is committed to delivering secure products. We test our products internally before we release them, and we strive to correct all vulnerabilities quickly. If you think that you might have identified a vulnerability in a Cisco product, contact PSIRT:

- Emergencies— *security-alert@cisco.com*
- Nonemergencies— *psirt@cisco.com*

> **Tip:** We encourage you to use Pretty Good Privacy (PGP) or a compatible product to encrypt any sensitive information that you send to Cisco. PSIRT can work from encrypted information that is compatible with PGP versions 2.x through 8.x.

Never use a revoked or an expired encryption key. The correct public key to use in your correspondence with PSIRT is the one that has the most recent creation date in this public key server list:

http://pgp.mit.edu:11371/pks/lookup?search=psirt%40cisco.com&op=index&exact=on

In an emergency, you can also reach PSIRT by telephone:

- 1 877 228-7302
- 1 408 525-6532

Obtaining Technical Assistance

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco Technical Support provides 24-hour-a-day, award-winning technical assistance. The Cisco Technical Support Website on Cisco.com features extensive online support resources. In addition, Cisco Technical Assistance Center (TAC) engineers provide telephone support. If you do not hold a valid Cisco service contract, contact your reseller.

Cisco Technical Support Website

The Cisco Technical Support Website provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The website is available 24 hours a day, 365 days a year, at this URL:

http://www.cisco.com/techsupport

Access to all tools on the Cisco Technical Support Website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register at this URL:

http://tools.cisco.com/RPF/register/register.do

> **Note:** Use the Cisco Product Identification (CPI) tool to locate your product serial number before submitting a web or phone request for service. You can access the CPI tool from the Cisco Technical Support Website by clicking the **Tools & Resources** link under Documentation & Tools. Choose **Cisco Product Identification Tool** from the Alphabetical Index drop-down list, or click the **Cisco Product Identification Tool** link under Alerts & RMAs. The CPI tool offers three search options: by product ID or model name; by tree view; or for certain products, by copying and pasting **show** command output. Search results show an illustration of your product with the serial number label location highlighted. Locate the serial number label on your product and record the information before placing a service call.

Submitting a Service Request

Using the online TAC Service Request Tool is the fastest way to open S3 and S4 service requests. (S3 and S4 service requests are those in which your network is minimally impaired or for which you require product information.) After you describe your situation, the TAC Service Request Tool provides recommended solutions. If your issue is not resolved using the recommended resources, your service request is assigned to a Cisco TAC engineer. The TAC Service Request Tool is located at this URL:

http://www.cisco.com/techsupport/servicerequest

For S1 or S2 service requests or if you do not have Internet access, contact the Cisco TAC by telephone. (S1 or S2 service requests are those in which your production network is down or severely degraded.) Cisco TAC engineers are assigned immediately to S1 and S2 service requests to help keep your business operations running smoothly.

To open a service request by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)
EMEA: +32 2 704 55 55
USA: 1 800 553-2447

For a complete list of Cisco TAC contacts, go to this URL:

http://www.cisco.com/techsupport/contacts

Definitions of Service Request Severity

To ensure that all service requests are reported in a standard format, Cisco has established severity definitions.

- Severity 1 (S1)—Your network is "down," or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.
- Severity 2 (S2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.
- Severity 3 (S3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.
- Severity 4 (S4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- Cisco Marketplace provides a variety of Cisco books, reference guides, and logo merchandise. Visit Cisco Marketplace, the company store, at this URL:

  http://www.cisco.com/go/marketplace/

- *Cisco Press* publishes a wide range of general networking, training and certification titles. Both new and experienced users will benefit from these publications. For current Cisco Press titles and other information, go to Cisco Press at this URL:

  http://www.ciscopress.com

- *Packet* magazine is the Cisco Systems technical user magazine for maximizing Internet and networking investments. Each quarter, Packet delivers coverage of the latest industry trends, technology breakthroughs, and Cisco products and solutions, as well as network deployment and troubleshooting tips, configuration examples, customer case studies, certification and training information, and links to scores of in-depth online resources. You can access Packet magazine at this URL:

  http://www.cisco.com/packet

- *iQ Magazine* is the quarterly publication from Cisco Systems designed to help growing companies learn how they can use technology to increase revenue, streamline their business, and expand services. The publication identifies the challenges facing these companies and the technologies to help solve them, using real-world case studies and business strategies to help readers make sound technology investment decisions. You can access iQ Magazine at this URL:

  http://www.cisco.com/go/iqmagazine

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

  http://www.cisco.com/ipj

- World-class networking training is available from Cisco. You can view current offerings at this URL:

  http://www.cisco.com/en/US/learning/index.html

FCC Statements for Cisco 1000 Series Lightweight Access Points

This section includes the following FCC statements for Cisco 1000 Series lightweight access points:

- *Class A Statement*
- *RF Radiation Hazard Warning*
- *Non-Modification Statement*
- *Deployment Statement*

Class A Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

RF Radiation Hazard Warning

To ensure compliance with FCC RF exposure requirements, this device must be installed in a location such that the antenna of the device will be greater than 20 cm (8 in.) from all persons. Using higher gain antennas and types of antennas not covered under the FCC certification of this product is not allowed.

Installers of the radio and end users of the Cisco Wireless LAN Solution must adhere to the installation instructions provided in this manual.

Non-Modification Statement

Use only the supplied internal antenna, or external antennas supplied by the manufacturer. Unauthorized antennas, modifications, or attachments could damage the badge and could violate FCC regulations and void the user's authority to operate the equipment.

> **Note:** Refer to the *Cisco WLAN Solution Release Notes* for 802.11a external antenna information. Contact Cisco for a list of FCC-approved 802.11a and 802.11b/g external antennas.

Deployment Statement

This product is certified for indoor deployment only. Do not install or use this product outdoors.

Industry Canada Required User Information for Cisco 1000 Series Lightweight Access Points

This device has been designed to operate with antennae having maximum gains of 7.8 dBi (2.4 GHz) and 7.4 dBi (5 GHz).

Antennae having higher gains is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

FCC Statements for Cisco 2000 Series Wireless LAN Controllers

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help. [cfr reference 15.105]

FCC Statements for Cisco 4100 Series Wireless LAN Controllers and Cisco 4400 Series Wireless LAN Controllers

The Cisco 4100 Series Wireless LAN Controller and Cisco 4400 Series Wireless LAN Controller equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Safety Considerations

Warning This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

- The 1000BASE-SX and 1000BASE-LX SFP modules and AIR-WLC4112-K9, AIR-WLC4124-K9, and AIR-WLC4136-K9 Cisco 4100 Series Wireless LAN Controllers contain Class 1 Lasers (Laser Klasse 1) according to EN 60825-1+A1+A2.

Warning Class 1 laser product. Statement 1008

Waarschuwing Klasse-1 laser produkt.

Varoitus Luokan 1 lasertuote.

Attention Produit laser de classe 1.

Warnung Laserprodukt der Klasse 1.

Avvertenza Prodotto laser di Classe 1.

Advarsel Laserprodukt av klasse 1.

Aviso Produto laser de classe 1.

¡Advertencia! Producto láser Clase I.

Varning! Laserprodukt av klass 1.

Figyelem **Class 1 besorolású lézeres termék.**

Предупреждение Лазерное устройство класса 1.

警告 这是 1 类激光产品。

警告 クラス1レーザー製品です。

주의 클래스 1 레이저 제품.

Aviso Produto a laser de classe 1.

Advarsel Klasse 1 laserprodukt.

تحذير **Class 1 Laser** منتج ١

Upozorenje **Laserski proizvod klase 1**

Upozornění **Laserový výrobek třídy 1.**

Προειδοποίηση Προϊόν λέιζερ κατηγορίας 1.

אזהרה .Class 1 מוצר לייזר

Opomena Ласерски производ од класа 1.

Ostrzeżenie **Produkt laserowy klasy 1.**

Upozornenie **Laserový výrobok triedy 1.**

- The Cisco 1000 Series lightweight access points with or without external antenna ports are only intended for installation in Environment A as defined in IEEE 802.3af. All interconnected equipment must be contained within the same building including the interconnected equipment's associated LAN connections.
- For AP1020 and AP1030 Cisco 1000 Series lightweight access points provided with optional external antenna ports, make sure that all external antennas and their associated wiring are located entirely indoors. Cisco 1000 Series lightweight access points and their optional external antennas are not suitable for outdoor use.
- MAKE SURE that plenum-mounted Cisco 1000 Series lightweight access points are powered using Power over Ethernet (PoE) to comply with safety regulations.
- For all Cisco Wireless LAN Controllers, verify that the ambient temperature remains between 0 and 40° C (32 and 104° F), taking into account the elevated temperatures that occur when they are installed in a rack.
- When multiple Cisco Wireless LAN Controllers are mounted in an equipment rack, be sure that the power source is sufficiently rated to safely run all of the equipment in the rack.
- Verify the integrity of the ground before installing Cisco Wireless LAN Controllers in an equipment rack
- Suitable for use in environmental air space in accordance with Section 300.22.C of the National Electrical Code, and Sections 2-128, 12-010(3) and 12-100 of the Canadian Electrical Code, Part 1, C22.1.

Warning This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available. Statement 1024

Waarschuwing Deze apparatuur dient geaard te zijn. De aardingsleiding mag nooit buiten werking worden gesteld en de apparatuur mag nooit bediend worden zonder dat er een op de juiste wijze geïnstalleerde aardingsleiding aanwezig is. Neem contact op met de bevoegde instantie voor elektrische inspecties of met een elektricien als u er niet zeker van bent dat er voor passende aarding gezorgd is.

Varoitus Laitteiden on oltava maadoitettuja. Älä koskaan ohita maajohdinta tai käytä laitteita ilman oikein asennettua maajohdinta. Ota yhteys sähkötarkastusviranomaiseen tai sähköasentajaan, jos olet epävarma maadoituksen sopivuudesta.

Attention Cet équipement doit être mis à la masse. Ne jamais rendre inopérant le conducteur de masse ni utiliser l'équipement sans un conducteur de masse adéquatement installé. En cas de doute sur la mise à la masse appropriée disponible, s'adresser à l'organisme responsable de la sécurité électrique ou à un électricien.

Warnung Dieses Gerät muss geerdet sein. Auf keinen Fall den Erdungsleiter unwirksam machen oder das Gerät ohne einen sachgerecht installierten Erdungsleiter verwenden. Wenn Sie sich nicht sicher sind, ob eine sachgerechte Erdung vorhanden ist, wenden Sie sich an die zuständige Inspektionsbehörde oder einen Elektriker.

Avvertenza Questa apparecchiatura deve essere dotata di messa a terra. Non escludere mai il conduttore di protezione né usare l'apparecchiatura in assenza di un conduttore di protezione installato in modo corretto. Se non si è certi della disponibilità di un adeguato collegamento di messa a terra, richiedere un controllo elettrico presso le autorità competenti o rivolgersi a un elettricista.

Advarsel Dette utstyret må jordes. Omgå aldri jordingslederen og bruk aldri utstyret uten riktig montert jordingsleder. Ta kontakt med fagfolk innen elektrisk inspeksjon eller med en elektriker hvis du er usikker på om det finnes velegnet jordning.

Aviso Este equipamento deve ser aterrado. Nunca anule o fio terra nem opere o equipamento sem um aterramento adequadamente instalado. Em caso de dúvida com relação ao sistema de aterramento disponível, entre em contato com os serviços locais de inspeção elétrica ou um eletricista qualificado.

¡Advertencia! Este equipo debe estar conectado a tierra. No inhabilite el conductor de tierra ni haga funcionar el equipo si no hay un conductor de tierra instalado correctamente. Póngase en contacto con la autoridad correspondiente de inspección eléctrica o con un electricista si no está seguro de que haya una conexión a tierra adecuada.

Varning! Denna utrustning måste jordas. Koppla aldrig från jordledningen och använd aldrig utrustningen utan en på lämpligt sätt installerad jordledning. Om det föreligger osäkerhet huruvida lämplig jordning finns skall elektrisk besiktningsauktoritet eller elektriker kontaktas.

Figyelem **A berendezés csak megfelelő védőföldeléssel működtethető. Ne iktassa ki a földelés csatlakozóját, és ne üzemeltesse a berendezést szabályosan felszerelt földelő vezeték nélkül! Ha nem biztos benne, hogy megfelelő földelés áll rendelkezésbe, forduljon a helyi elektromos hatóságokhoz vagy egy villanyszerelőhöz.**

Предупреждение Данное устройство должно быть заземлено. Никогда не отключайте провод заземления и не пользуйтесь оборудованием при отсутствии правильно подключенного провода заземления. За сведениями об имеющихся возможностях заземления обратитесь к соответствующим контролирующим организациям по энергоснабжению или к инженеру-электрику.

警告 此设备必须接地。切勿使接地导体失效，或者在没有正确安装接地导体的情况下操作该设备。如果您不能肯定接地导体是否正常发挥作用，请咨询有关电路检测方面的权威人士或电工。

警告 この装置はアース接続する必要があります。アース導体を破損しないよう注意し、アース導体を正しく取り付けないまま装置を稼働させないでください。アース接続が適正であるかどうか分からない場合には、電気検査機関または電気技術者に相談してください。

Warning To prevent bodily injury when mounting or servicing a unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:

- This unit should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack. Statement 1006

Waarschuwing Om lichamelijk letsel te voorkomen wanneer u dit toestel in een rek monteert of het daar een servicebeurt geeft, moet u speciale voorzorgsmaatregelen nemen om ervoor te zorgen dat het toestel stabiel blijft. De onderstaande richtlijnen worden verstrekt om uw veiligheid te verzekeren:

- Dit toestel dient onderaan in het rek gemonteerd te worden als het toestel het enige in het rek is.
- Wanneer u dit toestel in een gedeeltelijk gevuld rek monteert, dient u het rek van onderen naar boven te laden met het zwaarste onderdeel onderaan in het rek.
- Als het rek voorzien is van stabiliseringshulpmiddelen, dient u de stabilisatoren te monteren voordat u het toestel in het rek monteert of het daar een servicebeurt geeft.

Varoitus Kun laite asetetaan telineeseen tai huolletaan sen ollessa telineessä, on noudatettava erityisiä varotoimia järjestelmän vakavuuden säilyttämiseksi, jotta vältytään loukkaantumiselta. Noudata seuraavia turvallisuusohjeita:

- Jos telineessä ei ole muita laitteita, aseta laite telineen alaosaan.
- Jos laite asetetaan osaksi täytettyyn telineeseen, aloita kuormittaminen sen alaosasta kaikkein raskaimmalla esineellä ja siirry sitten sen yläosaan.
- Jos telinettä varten on vakaimet, asenna ne ennen laitteen asettamista telineeseen tai sen huoltamista siinä.

Attention Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnelþ:

- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.
- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

Warnung Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

Avvertenza Per evitare infortuni fisici durante il montaggio o la manutenzione di questa unità in un supporto, occorre osservare speciali precauzioni per garantire che il sistema rimanga stabile. Le seguenti direttive vengono fornite per garantire la sicurezza personale:

- Questa unità deve venire montata sul fondo del supporto, se si tratta dell'unica unità da montare nel supporto.
- Quando questa unità viene montata in un supporto parzialmente pieno, caricare il supporto dal basso all'alto, con il componente più pesante sistemato sul fondo del supporto.
- Se il supporto è dotato di dispositivi stabilizzanti, installare tali dispositivi prima di montare o di procedere alla manutenzione dell'unità nel supporto.

Advarsel Unngå fysiske skader under montering eller reparasjonsarbeid på denne enheten når den befinner seg i et kabinett. Vær nøye med at systemet er stabilt. Følgende retningslinjer er gitt for å verne om sikkerheten:

- Denne enheten bør monteres nederst i kabinettet hvis dette er den eneste enheten i kabinettet.
- Ved montering av denne enheten i et kabinett som er delvis fylt, skal kabinettet lastes fra bunnen og opp med den tyngste komponenten nederst i kabinettet.
- Hvis kabinettet er utstyrt med stabiliseringsutstyr, skal stabilisatorene installeres før montering eller utføring av reparasjonsarbeid på enheten i kabinettet.

Aviso Para se prevenir contra danos corporais ao montar ou reparar esta unidade numa estante, deverá tomar precauções especiais para se certificar de que o sistema possui um suporte estável. As seguintes directrizes ajudá-lo-ão a efectuar o seu trabalho com segurança:

- Esta unidade deverá ser montada na parte inferior da estante, caso seja esta a única unidade a ser montada.
- Ao montar esta unidade numa estante parcialmente ocupada, coloque os itens mais pesados na parte inferior da estante, arrumando-os de baixo para cima.
- Se a estante possuir um dispositivo de estabilização, instale-o antes de montar ou reparar a unidade.

¡Advertencia! Para evitar lesiones durante el montaje de este equipo sobre un bastidor, o posteriormente durante su mantenimiento, se debe poner mucho cuidado en que el sistema quede bien estable. Para garantizar su seguridad, proceda según las siguientes instrucciones:

- Colocar el equipo en la parte inferior del bastidor, cuando sea la única unidad en el mismo.
- Cuando este equipo se vaya a instalar en un bastidor parcialmente ocupado, comenzar la instalación desde la parte inferior hacia la superior colocando el equipo más pesado en la parte inferior.
- Si el bastidor dispone de dispositivos estabilizadores, instalar éstos antes de montar o proceder al mantenimiento del equipo instalado en el bastidor.

Varning! För att undvika kroppsskada när du installerar eller utför underhållsarbete på denna enhet på en ställning måste du vidta särskilda försiktighetsåtgärder för att försäkra dig om att systemet står stadigt. Följande riktlinjer ges för att trygga din säkerhet:

- Om denna enhet är den enda enheten på ställningen skall den installeras längst ned på ställningen.
- Om denna enhet installeras på en delvis fylld ställning skall ställningen fyllas nedifrån och upp, med de tyngsta enheterna längst ned på ställningen.
- Om ställningen är försedd med stabiliseringsdon skall dessa monteras fast innan enheten installeras eller underhålls på ställningen.

Figyelem **A készülék rackbe történő beszerelése és karbantartása során bekövetkező sérülések elkerülése végett speciális óvintézkedésekkel meg kell őrizni a rendszer stabilitását. A személyes biztonsága érdekében tartsa be a következő szabályokat:**

- **Ha a rackben csak ez az egy készülék található, a rack aljába kell beszerelni.**
- **Ha nincs teljesen tele az a rack, amelybe beszerelik a készüléket, alulról fölfelé haladva töltse fel a racket úgy, hogy a legnehezebb készülék kerüljön a rack aljába.**
- **Ha stabilizáló eszközök is tartoznak a rackhez, szerelje fel a stabilizátorokat, mielőtt beszerelné az egységet a rackbe, vagy karbantartást végezne rajta.**

Предупреждение Во избежание травм при монтаже и обслуживании устройства в стойке следует принять особые меры предосторожности, чтобы убедиться в устойчивости оборудования.
Для обеспечения безопасности работ необходимо соблюдать следующие правила.

- Если в стойке находится одно устройство, оно должно быть установлено в нижней части.
- При монтаже устройств в частично заполненную стойку устанавливайте оборудование снизу вверх, размещая наиболее тяжелые устройства в нижней части.
- Если стойка снабжена приспособлениями для стабилизации, их необходимо установить до начала монтажа или обслуживания оборудования.

警告 为避免在机架中安装或维修该部件时使身体受伤，您必须采取特殊的预防措施确保系统固定。以下是确保安全的原则：

- 如果此部件是机架中唯一的部件，应将其安装在机架的底部。
- 如果在部分装满的机架中安装此部件，请按从下往上的顺序安装各个部件，并且最重的组件应安装在机架的底部。
- 如果机架配有固定装置，请先装好固定装置，然后再在机架中安装或维修部件。

警告 この装置をラックに設置したり保守作業を行ったりするときは、人身事故を防ぐため、システムが安定しているかどうかを十分に確認する必要があります。次の注意事項に従ってください。

- ラックにこの装置を単独で設置する場合は、ラックの一番下に設置します。
- ラックに別の装置がすでに設置されている場合は、最も重量のある装置を一番下にして、重い順に下から上へ設置します。
- ラックに安定器具が付属している場合は、その安定器具を取り付けてから、装置をラックに設置するか、またはラック内の装置の保守作業を行ってください。

주의 이 장치를 랙에 장착하거나 서비스할 때 신체 부상을 방지하려면, 시스템이 안정된 상태를 유지하도록 특별히 주의해야 합니다. 사용자의 안전을 위해 다음 지침 사항을 준수하십시오.

- 이 장치가 랙에 장착되는 유일한 것일 경우, 랙의 맨 아래 부분에 장착되어야 합니다.
- 부분적으로 차 있는 랙에 이 장치를 장착할 경우, 가장 무거운 장치를 랙의 맨 아래 부분부터 차례로 장착하십시오.
- 안정기가 랙과 함께 제공되는 경우, 이 안정기를 설치한 후 이 장치를 랙에 장착하거나 서비스하십시오

Aviso Para evitar lesões corporais ao montar ou dar manutenção a esta unidade em um rack, é necessário tomar todas as precauções para garantir a estabilidade do sistema. As seguintes orientações são fornecidas para garantir a sua segurança:

- Se esta for a única unidade, ela deverá ser montada na parte inferior do rack.
- Ao montar esta unidade em um rack parcialmente preenchido, carregue-o de baixo para cima com o componente mais pesado em sua parte inferior.
- Se o rack contiver dispositivos estabilizadores, instale-os antes de montar ou dar manutenção à unidade existente.

Advarsel For at forhindre legemesbeskadigelse ved montering eller service af denne enhed i et rack, skal du sikre at systemet står stabilt. Følgende retningslinjer er også for din sikkerheds skyld:

- Enheden skal monteres i bunden af dit rack, hvis det er den eneste enhed i racket.
- Ved montering af denne enhed i et delvist fyldt rack, skal enhederne installeres fra bunden og opad med den tungeste enhed nederst.
- Hvis racket leveres med stabiliseringsenheder, skal disse installeres for enheden monteres eller serviceres i racket.

تحذير لتجنب حدوث أي إصابات عند تركيب هذه الوحدة، يجب اتباع بعض الاحتياطات لضمان عمل النظام بشكل سليم. يتم ذكر الإرشادات التالية لضمان الأمان.
يجب تركيب هذه الوحدة في الجزء السفلي من الدولاب المتضمن قضبان إذا كانت هذه الوحدة هي الوحدة الوحيدة في الدولاب الذي يحتوي على قضبان.
عند تركيب هذه الوحدة في دولاب شبه ممتلئ، قم برفع الدولاب من الجزء السفلي لأعلى بحيث يكون الجزء الأثقل وزناً أسفل الدولاب.
إذا كان الدولاب المتضمن قضباناً يحتوي على أجهزة حفظ التوازن، قم بتثبيت هذه الأجهزة قبل تركيب الوحدة في الدولاب.

Upozorenje **Kako ne bi došlo do tjelesnih ozljeda kod postavljanja ili servisiranja uređaja na polici, potrebno je poduzeti mjere predostrožnosti kako bi sustav uvijek bio stabilan. Sigurnost se može osigurati poštivanjem sljedećih smjernica:**

- **Ovaj uređaj treba ugraditi na dno police, ukoliko je to jedini uređaj na polici.**
- **Kod ugradnje uređaja u policu na kojoj se već nalaze drugi uređaji, policu treba opremati počevši od dna, te tako da se na dno stave najteži dijelovi.**
- **Ukoliko su na polici ugrađeni stabilizatori, njih montirajte prije ugradnje ili servisiranja uređaja na polici.**

Upozornění **Abyste předešli poranění osob při montáži nebo opravě zařízení v montážním rámu, musíte dodržovat zvláštní preventivní opatření pro zajištění udržení stability systému. Pro zajištění bezpečnosti obsluhy jsou určeny následující zásady:**

- **Pokud je toto zařízení jedinou jednotkou v montážním rámu, musí být namontováno na nejnižší místo rámu.**
- **Pokud je toto zařízení montováno do částečně obsazeného montážního rámu, obsazujte montážní rám ve směru zdola nahoru tak, aby byla nejtěžší součást nejníže.**
- **Pokud je montážní rám vybaven stabilizačními zařízeními, nainstalujte stabilizátory ještě před montáží nebo opravou zařízení v montážním rámu.**

Προειδοποίηση Για να αποφύγετε τον τραυματισμό κατά την τοποθέτηση ή τη συντήρηση αυτής της συσκευής σε αρθρωτό σύστημα, πρέπει να λάβετε ειδικές προφυλάξεις για να διασφαλίσετε τη σταθερότητα του συστήματος. Οι παρακάτω οδηγίες παρέχονται για να εξασφαλίσουν την ασφάλειά σας:

- Αυτή η συσκευή πρέπει να τοποθετείται στο κάτω μέρος του αρθρωτού συστήματος αν είναι η μοναδική συσκευή σε αυτό.
- Όταν τοποθετείτε αυτήν τη συσκευή σε εν μέρει γεμάτο αρθρωτό σύστημα, τοποθετήστε συσκευές στο αρθρωτό σύστημα από κάτω προς τα επάνω, με τη βαρύτερη συσκευή στο κάτω μέρος του συστήματος.
- Εάν το αρθρωτό σύστημα διαθέτει διατάξεις σταθεροποίησης, τοποθετήστε τους σταθεροποιητές πριν τοποθετήσετε ή συντηρήσετε τη συσκευή στο αρθρωτό σύστημα.

אזהרה כדי למנוע פציעה בעת הרכבת יחידה זו במעמד או טיפול בה, עליך לנקוט אמצעי זהירות מיוחדים כדי להבטיח את יציבות המערכת. הקווים המנחים הבאים ניתנים על מנת להבטיח את ביטחונך:

- אם יחידה זו היא יחידה בודדת במעמד, יש להרכיב את היחידה בחלקו התחתון של המעמד.
- בעת הרכבת יחידה זו במעמד המלא בחלקו, טען את המעמד החל בחלק התחתון וכלפי מעלה כאשר הרכיב הכבד ביותר נמצא בחלקו התחתון של המעמד.
- אם המעמד מסופק עם התקני ייצוב, התקן את המייצבים לפני הרכבה היחידה במעמד או טיפול בה.

Opomena За да се не повредите кога го монтирате или го сервисирате уредот на полица, мора да бидете особено претпазливи за да ја обезбедите стабилноста на системот. Следите напатствија се дадени за да ја осигураат Вашата безбедност:

- Уредот треба да се монтира најдолу на полицата ако е единствен уред на полицата.
- Кога го монтирате уредот на делумно пополнета полица, полнете ја полицата од дното кон врвот со најтешката компонента на дното на полицата.
- Ако полицата има стабилизаторски делови, наместете ги стабилизаторите пред да го монтирате или сервисирате уредот на полицата.

Warning There is the danger of explosion if the Cisco 4400 Series Wireless LAN Controller battery is replaced incorrectly. Replace the battery only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions. Statement 1015

Waarschuwing Er is ontploffingsgevaar als de batterij verkeerd vervangen wordt. Vervang de batterij slechts met hetzelfde of een equivalent type dat door de fabrikant aanbevolen is. Gebruikte batterijen dienen overeenkomstig fabrieksvoorschriften weggeworpen te worden.

Varoitus Räjähdyksen vaara, jos akku on vaihdettu väärään akkuun. Käytä vaihtamiseen ainoastaan saman- tai vastaavantyyppistä akkua, joka on valmistajan suosittelema. Hävitä käytetyt akut valmistajan ohjeiden mukaan.

Attention Danger d'explosion si la pile n'est pas remplacée correctement. Ne la remplacer que par une pile de type semblable ou équivalent, recommandée par le fabricant. Jeter les piles usagées conformément aux instructions du fabricant.

Warnung Bei Einsetzen einer falschen Batterie besteht Explosionsgefahr. Ersetzen Sie die Batterie nur durch den gleichen oder vom Hersteller empfohlenen Batterietyp. Entsorgen Sie die benutzten Batterien nach den Anweisungen des Herstellers.

Avvertenza Pericolo di esplosione se la batteria non è installata correttamente. Sostituire solo con una di tipo uguale o equivalente, consigliata dal produttore. Eliminare le batterie usate secondo le istruzioni del produttore.

Advarsel Det kan være fare for eksplosjon hvis batteriet skiftes på feil måte. Skift kun med samme eller tilsvarende type som er anbefalt av produsenten. Kasser brukte batterier i henhold til produsentens instruksjoner.

Aviso Existe perigo de explosão se a bateria for substituída incorrectamente. Substitua a bateria por uma bateria igual ou de um tipo equivalente recomendado pelo fabricante. Destrua as baterias usadas conforme as instruções do fabricante.

¡Advertencia! Existe peligro de explosión si la batería se reemplaza de manera incorrecta. Reemplazar la batería exclusivamente con el mismo tipo o el equivalente recomendado por el fabricante. Desechar las baterías gastadas según las instrucciones del fabricante.

Varning! Explosionsfara vid felaktigt batteribyte. Ersätt endast batteriet med samma batterityp som rekommenderas av tillverkaren eller motsvarande. Följ tillverkarens anvisningar vid kassering av använda batterier.

Figyelem **Robbanásveszélyt idézhet elő, ha helytelenül cserélik ki az akkumulátort. Csak a gyártó által javasolttal megegyező vagy azzal egyenértékű típusúra cserélje ki az akkumulátort! A használt akkumulátorok kidobásakor tartsa be a gyártó előírásait!**

Предупреждение При неправильной замене батареи возможен взрыв. Для замены следует использовать батарею того же или аналогичного типа, рекомендованного изготовителем. Утилизацию батареи необходимо производить в соответствии с указаниями изготовителя.

警告 电池更换不当会有爆炸危险。请只用同类电池或制造商推荐的功能相当的电池更换原有电池。请按制造商的说明处理废旧电池。

警告 不適切なバッテリに交換すると、爆発の危険性があります。製造元が推奨するものと同じまたは同等のバッテリだけを使用してください。使用済みのバッテリは、製造元が指示する方法に従って処分してください。

Warning Only trained and qualified personnel should be allowed to install, replace, or service this equipment. Statement 1030

Waarschuwing Deze apparatuur mag alleen worden geïnstalleerd, vervangen of hersteld door bevoegd geschoold personeel.

Varoitus Tämän laitteen saa asentaa, vaihtaa tai huoltaa ainoastaan koulutettu ja laitteen tunteva henkilökunta.

Attention Il est vivement recommandé de confier l'installation, le remplacement et la maintenance de ces équipements à des personnels qualifiés et expérimentés.

Warnung Das Installieren, Ersetzen oder Bedienen dieser Ausrüstung sollte nur geschultem, qualifiziertem Personal gestattet werden.

Avvertenza Questo apparato può essere installato, sostituito o mantenuto unicamente da un personale competente.

Advarsel Bare opplært og kvalifisert personell skal foreta installasjoner, utskiftninger eller service på dette utstyret.

Aviso Apenas pessoal treinado e qualificado deve ser autorizado a instalar, substituir ou fazer a revisão deste equipamento.

¡Advertencia! Solamente el personal calificado debe instalar, reemplazar o utilizar este equipo.

Varning! Endast utbildad och kvalificerad personal bör få tillåtelse att installera, byta ut eller reparera denna utrustning.

Figyelem **A berendezést csak szakképzett személyek helyezhetik üzembe, cserélhetik és tarthatják karban.**

Предупреждение Установку, замену и обслуживание этого оборудования может осуществлять только специально обученный квалифицированный персонал.

警告 只有经过培训且具有资格的人员才能进行此设备的安装、更换和维修。

警告 この装置の設置、交換、保守は、訓練を受けた相応の資格のある人が行ってください。

주의 교육을 받고 자격을 갖춘 사람만 이 장비를 설치, 교체, 또는 서비스를 수행해야 합니다.

Aviso Somente uma equipe treinada e qualificada tem permissão para instalar, substituir ou dar manutenção a este equipamento.

Advarsel Kun uddannede personer må installere, udskifte komponenter i eller servicere dette udstyr.

تحذير يسمح للفنيين المتخصصين فقط بتركيب المعدة أو استبدالها أو إجراء الصيانة عليها.

Upozorenje **Uređaj smije ugrađivati, mijenjati i servisirati samo za to obučeno i osposobljeno servisno osoblje.**

Upozornění **Instalaci, výměnu nebo opravu tohoto zařízení smějí provádět pouze proškolené a kvalifikované osoby.**

Προειδοποίηση Η τοποθέτηση, η αντικατάσταση και η συντήρηση του εξοπλισμού επιτρέπεται να γίνονται μόνο από καταρτισμένο προσωπικό με τα κατάλληλα προσόντα.

אזהרה רק עובדים מיומנים ומוסמכים רשאים להתקין, להחליף, או לטפל בציד זה.

Opomena Местењето, заменувањето и сервисирањето на оваа опрема треба да му биде дозволено само на обучен и квалификуван персонал.

Ostrzeżenie **Do instalacji, wymiany i serwisowania tych urządzeń mogą być dopuszczone wyłącznie osoby wykwalifikowane i przeszkolone.**

Upozornenie **Inštaláciu, výmenu alebo opravu tohto zariadenia smú vykonávať iba vyškolené a kvalifikované osoby.**

Warning The Cisco 4400 Series Wireless LAN Controller might have more than one power supply connection. All connections must be removed to de-energize the unit. Statement 1028

Waarschuwing Deze eenheid kan meer dan één stroomtoevoeraansluiting bevatten. Alle aansluitingen dienen ontkoppeld te worden om de eenheid te ontkrachten.

Varoitus Tässä laitteessa voi olla useampia kuin yksi virtakytkentä. Kaikki liitännät on irrotettava, jotta jännite poistetaan laitteesta.

Attention Cette unité peut avoir plus d'une connexion d'alimentation. Pour supprimer toute tension et tout courant électrique de l'unité, toutes les connexions d'alimentation doivent être débranchées.

Warnung Dieses Gerät kann mehr als eine Stromzufuhr haben. Um sicherzustellen, dass der Einheit kein Strom zugeführt wird, müssen alle Verbindungen entfernt werden.

Avvertenza Questa unità può avere più di una connessione all'alimentazione elettrica. Tutte le connessioni devono essere staccate per togliere la corrente dall'unità.

Advarsel Denne enheten kan ha mer enn én strømtilførselskobling. Alle koblinger må fjernes fra enheten for å utkoble all strøm.

Aviso Esta unidade poderá ter mais de uma conexão de fonte de energia. Todas as conexões devem ser removidas para desligar a unidade.

¡Advertencia! Puede que esta unidad tenga más de una conexión para fuentes de alimentación. Para cortar por completo el suministro de energía, deben desconectarse todas las conexiones.

Varning! Denna enhet har eventuellt mer än en strömförsörjningsanslutning. Alla anslutningar måste tas bort för att göra enheten strömlös.

Figyelem **Előfordulhat, hogy a készülék többszörösen van csatlakoztatva az áramforráshoz. A készülék áramtalanításához mindegyik csatlakozást meg kell szüntetni.**

Предупреждение В данном устройстве может использоваться несколько подключений к электросети. Чтобы обесточить устройство, необходимо отключить все эти подключения.

警告 此部件连接的电源可能不止一个。必须将所有电源断开才能停止给该部件供电。

警告 この装置には、複数の電源が接続されている場合があります。装置の電源を完全にオフにするには、すべての電源を切断する必要があります。

주의 본 장치에는 2개 이상의 전원 공급 연결 단자가 있을 수 있습니다. 이 장치의 전원을 차단하려면 모든 연결 단자를 제거해야 합니다.

Aviso Esta unidade pode ter mais de uma conexão de fonte de alimentação. Todas as conexões devem ser removidas para interromper a alimentação da unidade.

Advarsel Denne enhed har muligvis mere end en strømforsyningstilslutning. Alle tilslutninger skal fjernes for at aflade strømmen fra enheden.

تحذير قد تتضمن هذه الوحدة أكثر من اتصال بمورد الطاقة. يجب فصل كافة التوصيلات حتى يمكن إفراغ طاقة الوحدة.

Upozorenje **Uređaj može imati više priključaka za izvore napajanja. Za potpuno isključivanje napajanja potrebno je iskopčati sve priključke.**

Upozornění **Toto zařízení může být připojeno k více než jednomu zdroji napájení. Aby se zařízení zcela odpojilo od proudu, musí být odpojeno od všech zdrojů napájení.**

Προειδοποίηση Αυτή η συσκευή ίσως να έχει περισσότερες συνδέσεις τροφοδοσίας.
Για να απενεργοποιηθεί η συσκευή, πρέπει να αφαιρεθούν όλες οι συνδέσεις.

אזהרה ייתכן שביחידה זו קיים יותר מחיבור אחד לספק כוח. יש להסיר את כל החיבורים כדי להפסיק את אספקת המתח ליחידה.

Opomena Уредот може да има повеќе од еден приклучок за напојување. Сите приклучоци мора да се извадат за да се прекине доводот на енергија во уредот.

Ostrzeżenie **To urządzenie może mieć podłączone więcej niż jedno źródło zasilania. Aby całkowicie odciąć dopływ energii do urządzenia, należy odłączyć wszystkie źródła zasilania.**

Upozornenie **Toto zariadenie môže byť pripojené k viac ako jednému zdroju napájania. Aby sa zariadenie odpojilo od prúdu, musí byť odpojené od všetkých zdrojov.**

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Refer to the following for information about the Cisco Wireless LAN Solution (Cisco WLAN Solution) and other high-level subjects:

- *About the Cisco Wireless LAN Solution*
  - *Single-Cisco Wireless LAN Controller Deployments*
  - *Multiple-Cisco Wireless LAN Controller Deployments*
  - *Operating System Software*
  - *Operating System Security*
  - *Cisco WLAN Solution Wired Security*
  - *Layer 2 and Layer 3 LWAPP Operation*
  - *Radio Resource Management (RRM)*
  - *Master Cisco Wireless LAN Controller*
  - *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller*
  - *Client Roaming*
  - *Client Location*
  - *External DHCP Servers*
  - *Cisco WLAN Solution Mobility Group*
  - *Cisco WLAN Solution Wired Connections*
  - *Cisco WLAN Solution WLANs*
  - *Identity Networking*
  - *Transferring Files*
  - *Power Over Ethernet*
  - *Pico Cell Functionality*
  - *Intrusion Detection Service (IDS)*
- *Cisco Wireless LAN Controllers*
- *Cisco 1000 Series Lightweight Access Points*
- *Rogue Access Points*
- *Web User Interface*
- *Command Line Interface*
- *Cisco Wireless Control System*
  - *Cisco WCS Base*
  - *Cisco WCS Location*
  - *Cisco WCS User Interface*
  - *Floor Plan Editor*
  - *Cisco WCS Cisco Wireless LAN Controller Autodiscovery*
  - *Cisco WCS Alarm Email Notification*

- *Cisco WCS Location Calibration*

- *Cisco 2700 Series Location Appliances*
- *REFERENCES*

About the Cisco Wireless LAN Solution

The Cisco Wireless LAN Solution (Cisco WLAN Solution) is designed to provide 802.11 wireless networking solutions for enterprises and service providers. The Cisco WLAN Solution simplifies deploying and managing large-scale wireless LANs and enables a unique best-in-class security infrastructure. The Operating System manages all data client, communications, and system administration functions, performs *Radio Resource Management (RRM)* functions, manages system-wide mobility policies using the Operating System Security solution, and coordinates all security functions using the *Operating System Security* framework.

The Cisco WLAN Solution consists of *Cisco Wireless LAN Controllers* and their associated *Cisco 1000 Series Lightweight Access Points* controlled by the Operating System, all concurrently managed by any or all of the Operating System user interfaces:

- An HTTP and/or HTTPS full-featured Web User Interface hosted by Cisco Wireless LAN Controllers, can be used to configure and monitor individual Cisco Wireless LAN Controllers. See the *Web User Interface* section.
- A full-featured CLI (command line interface) can be used to configure and monitor individual Cisco Wireless LAN Controllers. Refer to the *Command Line Interface* section.
- The *Cisco Wireless Control System* (Cisco WCS) interface is used to configure and monitor one or more Cisco Wireless LAN Controllers and associated access points, and has tools to facilitate large-system monitoring and control. The Cisco Wireless Control System runs on Windows 2000, Windows 2003, and Red Hat Enterprise Linux ES servers.
- An industry-standard SNMP V1, V2c, and V3 interface can be used with any SNMP-compliant third-party network management system.

The Cisco WLAN Solution supports client data services, client monitoring and control, and all rogue access point detection, monitoring and containment functions. The Cisco WLAN Solution uses Cisco 1000 Series lightweight access points, Cisco Wireless LAN Controllers, and optional Cisco Wireless Control System Cisco Wireless Control System to provide wireless services to enterprises and service providers.

The Cisco WCS application is offered in two versions:

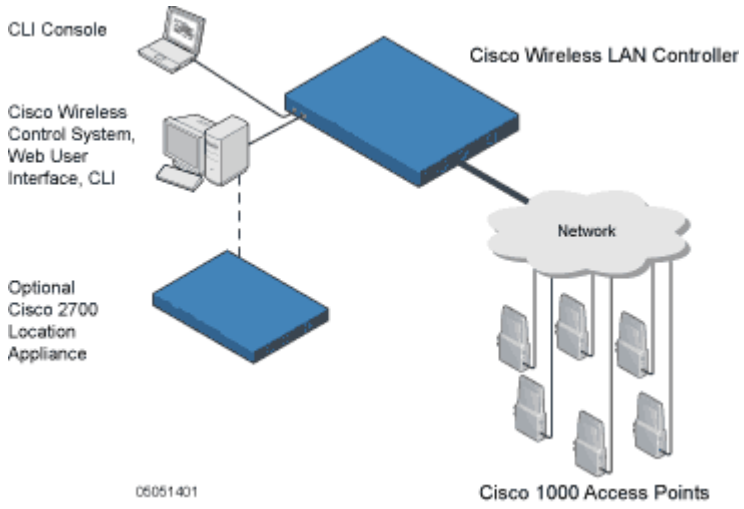
- *Cisco WCS Base*, which also supports client, rogue access point, rogue assess point client, radio frequency ID (RFID) tag location to the nearest Cisco 1000 Series lightweight access point.
- *Cisco WCS Location*, which also supports client, rogue access point, rogue assess point client, RFID tag location to within 10 meters.

When Cisco WCS Location is used, Cisco WLAN Solution end users can also deploy Cisco 2700 Series Location Appliances (location appliances), described in the *Cisco 2700 Series Location Appliances* section. The location appliance enhances the high-accuracy built-in Cisco WCS Location abilities by computing, collecting and storing historical location data, which can be displayed in Cisco WCS. In this role, the location appliance acts as a server to one or more Cisco WCS Servers, collecting, storing, and passing on data from its associated Cisco Wireless LAN Controllers.

The following figure shows the Cisco WLAN Solution components, which can be simultaneously deployed across multiple floors and buildings.

> **Note:** This document refers to Cisco Wireless LAN Controllers throughout. Unless specifically called out, the descriptions herein apply to all Cisco Wireless LAN Controllers, including but not limited to Cisco 2000 Series Wireless LAN Controllers, Cisco 4100 Series Wireless LAN Controllers, and Cisco 4400 Series Wireless LAN Controllers.

Figure - Cisco WLAN Solution Components



Refer to the following for more information:

- *Single-Cisco Wireless LAN Controller Deployments*
- *Multiple-Cisco Wireless LAN Controller Deployments*
- *Operating System Software*
- *Operating System Security*
- *Cisco WLAN Solution Wired Security*
- *Layer 2 and Layer 3 LWAPP Operation*
- *Radio Resource Management (RRM)*
  - *Master Cisco Wireless LAN Controller*
  - *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller*
  - *Client Roaming*
  - *Client Location*
  - *External DHCP Servers*
  - *Cisco WLAN Solution Mobility Group*
  - *Cisco WLAN Solution Wired Connections*
  - *Cisco WLAN Solution WLANs*
  - *Transferring Files*
  - *Power Over Ethernet*
- *Cisco Wireless LAN Controllers*
- *Cisco 1000 Series Lightweight Access Points*
- *Rogue Access Points*
- *Web User Interface*
- *Command Line Interface*

- *Cisco Wireless Control System*
  - *Cisco WCS User Interface*
  - *Floor Plan Editor*
  - *Cisco WCS Cisco Wireless LAN Controller Autodiscovery*
- *Cisco 2700 Series Location Appliances*
- *REFERENCES*

Single-Cisco Wireless LAN Controller Deployments

As described in *About the Cisco Wireless LAN Solution*, a standalone Cisco Wireless LAN Controller can support Cisco 1000 Series lightweight access points across multiple floors and buildings simultaneously, and supports the following features:

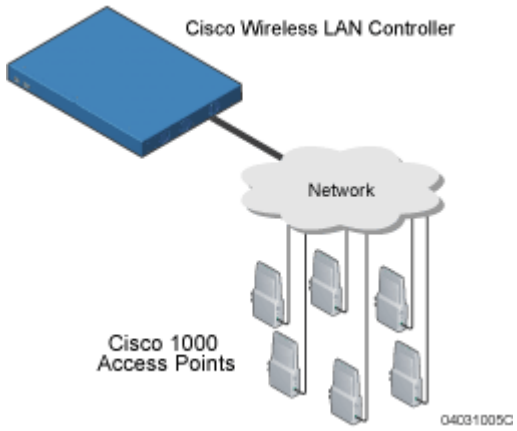
- Autodetecting and autoconfiguring Cisco 1000 Series lightweight access points as they are added to the network, as described in *Radio Resource Management (RRM)*.
- Full control of *Cisco 1000 Series Lightweight Access Points*.
- Full control of up to 16 Cisco 1000 Series lightweight access point WLAN (SSID) policies, as described in *Cisco WLAN Solution WLANs*.

  Note: Some Cisco Wireless LAN Controllers can connect through multiple physical ports to multiple subnets in the network. This can be helpful, for instance, when Cisco WLAN Solution operators want to confine multiple VLANs to separate subnets.

- Cisco 1000 Series lightweight access points connect to Cisco Wireless LAN Controllers through the network. The network equipment may or may not provide *Power Over Ethernet* to the Cisco 1000 Series lightweight access points.

Note that some Cisco Wireless LAN Controllers use redundant GigE connections to bypass single network failures. At any given time one of the redundant GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.

Figure - Typical Cisco Wireless LAN Controller Deployed



Multiple-Cisco Wireless LAN Controller Deployments

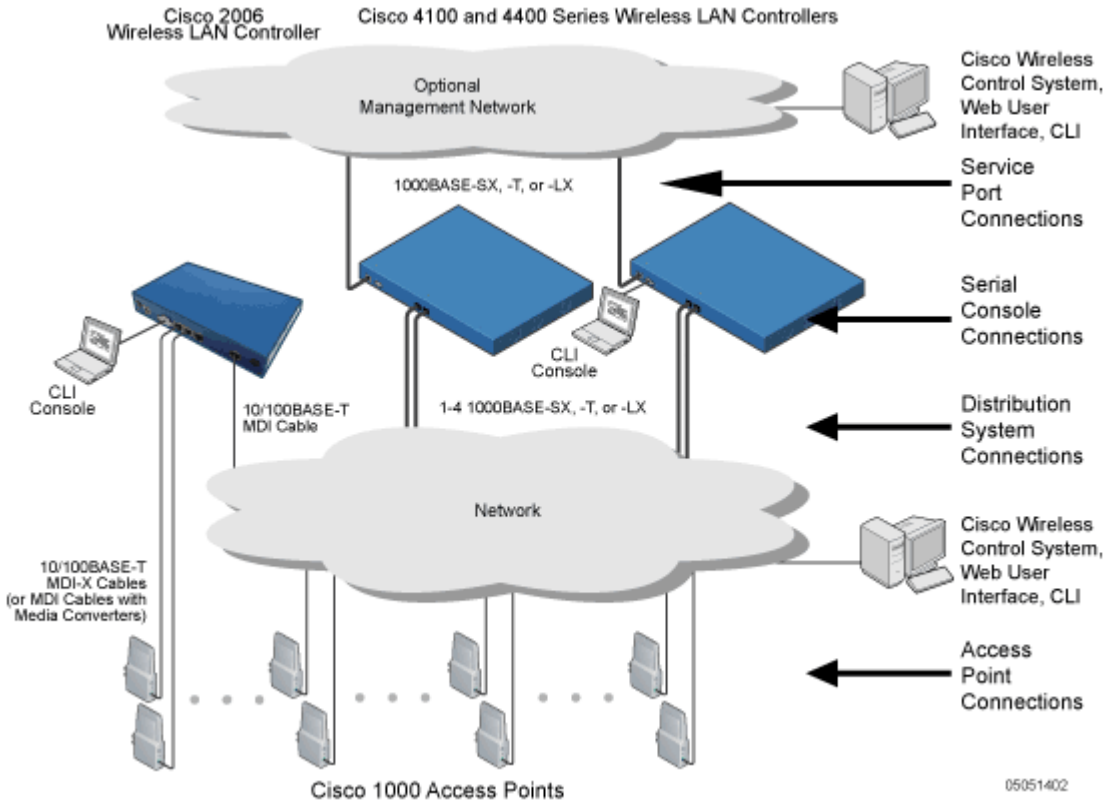
Each Cisco Wireless LAN Controller can support Cisco 1000 Series lightweight access points across multiple floors and buildings simultaneously. However, full functionality of the Cisco WLAN Solution is realized when it includes multiple Cisco Wireless LAN Controllers. That is, a multiple-Cisco Wireless LAN Controller system has the following additional features over a single-Cisco Wireless LAN Controller deployment:

- Autodetecting and autoconfiguring Cisco Wireless LAN Controller RF parameters as the Cisco Wireless LAN Controllers are added to the network, as described in *Radio Resource Management (RRM)*.
- *Same-Cisco Wireless LAN Controller (Layer 2) Roaming* and *Inter-Subnet (Layer 3) Roaming*.
- Automatic Cisco 1000 Series lightweight access point failover to any redundant Cisco Wireless LAN Controller with unused ports (refer to *Cisco Wireless LAN Controller Failover Protection*).

The following figure shows a typical multiple-Cisco Wireless LAN Controller deployment. The figure also shows an optional dedicated Management Network, and the three physical connection types between the network and the Cisco Wireless LAN Controllers, as further described in *Network Connections to Cisco Wireless LAN Controllers*.

> **Note:** Cisco Wireless LAN Controller can connect through the Management Interface to multiple subnets in the Network. This can be helpful, for instance, when Cisco WLAN Solution operators want to confine multiple VLANs to separate subnets using *Operator-Defined Interfaces*.

Figure - Typical Multiple-Cisco Wireless LAN Controller Deployment



About the Operating System Software

The Operating System Software controls Cisco Wireless LAN Controllers and Cisco 1000 Series Lightweight Access Points. It includes full *Operating System Security* and *Radio Resource Management (RRM)* features.

About Operating System Security

Operating System Security bundles Layer 1, Layer 2 and Layer 3 security components into a simple, Cisco WLAN Solution-wide policy manager that creates independent security policies for each of up to 16 WLANs. (Refer to *Cisco WLAN Solution WLANs*.)

One of the barriers that made enterprises avoid deploying 802.11 networks was the inherent weakness of 802.11 Static WEP (Wired Equivalent Privacy) encryption. Because WEP is so insecure, enterprises have been looking for more secure solutions for business-critical traffic.

The 802.11 Static WEP weakness problem can be overcome using robust industry-standard security solutions, such as:

- 802.1X dynamic keys with EAP (extensible authentication protocol).
- WPA (Wi-Fi protected access) dynamic keys. The Cisco WLAN Solution WPA implementation includes:
  - TKIP + Michael (temporal key integrity protocol + message integrity code checksum) dynamic keys, or
  - WEP (Wired Equivalent Privacy) keys, with or without Pre-Shared key Passphrase.
- RSN with or without Pre-Shared key.
- Cranite FIPS140-2 compliant passthrough.
- Fortress FIPS140-2 compliant passthrough.
- Optional MAC Filtering.

The WEP problem can be further solved using industry-standard Layer 3 security solutions, such as:

- Terminated and passthrough VPNs (virtual private networks), and
- Terminated and passthrough L2TP (Layer Two Tunneling Protocol), which uses the IPSec (IP Security) protocol.
- Terminated and pass-through IPSec (IP security) protocols. The terminated Cisco WLAN Solution IPSec implementation includes:
  - IKE (internet key exchange),
  - DH (Diffie-Hellman) groups, and
  - Three optional levels of encryption: DES (ANSI X.3.92 data encryption standard), 3DES (ANSI X9.52-1998 data encryption standard), or AES/CBC (advanced encryption standard/cipher block chaining).

  The Cisco WLAN Solution IPSec implementation also includes industry-standard authentication using:
  - MD5 (message digest algorithm), or
  - SHA-1 (secure hash algorithm-1).
- The Cisco WLAN Solution supports local and RADIUS MAC Address (media access control) filtering.
- The Cisco WLAN Solution supports local and RADIUS user/password authentication.

- The Cisco WLAN Solution also uses manual and automated Disabling to block access to network services. In manual Disabling, the operator blocks access using client MAC addresses. In automated Disabling, which is always active, the Operating System software automatically blocks access to network services for an operator-defined period of time when a client fails to authenticate for a fixed number of consecutive attempts. This can be used to deter brute-force login attacks.

These and other *Cisco WLAN Solution Security* features use industry-standard authorization and authentication methods to ensure the highest possible security for your business-critical wireless LAN traffic.

For information about Cisco WLAN Solution wired security, refer to *Cisco WLAN Solution Wired Security*.

About Cisco WLAN Solution Wired Security

Many traditional Access Point vendors concentrate on security for the Wireless interface similar to that described in the *Operating System Security* section. However, for secure Cisco Wireless LAN Controller Service Interfaces (*Cisco Wireless Control System*, *Web User Interface*, and *Command Line Interface*), Cisco Wireless LAN Controller to AP, and inter-Cisco Wireless LAN Controller communications during device servicing and *Client Roaming*, the Operating System includes built-in security.

Each Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access point is manufactured with a unique, signed X.509 certificate. This certificate is used to authenticate IPSec tunnels between devices. These IPSec tunnels ensure secure communications for mobility and device servicing.

Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points also use the signed certificates to verify downloaded code before it is loaded, ensuring that hackers do not download malicious code into any Cisco Wireless LAN Controller or Cisco 1000 Series lightweight access point.

For information about Cisco WLAN Solution wireless security, refer to *Operating System Security*.

Layer 2 and Layer 3 LWAPP Operation

The LWAPP communications between Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access points can be conducted at ISO Data Link Layer 2 or Network Layer 3.

Operational Requirements

The requirement for Layer 2 LWAPP communications is that the Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access points must be connected to each other through Layer 2 devices on the same subnet. This is the default operational mode for the Cisco WLAN Solution. Note that when the Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access points are on different subnets, these devices must be operated in Layer 3 mode.

The requirement for Layer 3 LWAPP communications is that the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points can be connected through Layer 2 devices on the same subnet, or connected through Layer 3 devices across subnets.

Note that all Cisco Wireless LAN Controllers in an *Cisco WLAN Solution Mobility Group* must use the same LWAPP Layer 2 or Layer 3 mode, or you will defeat the Mobility software algorithm.

Configuration Requirements

When you are operating the Cisco WLAN Solution in Layer 2 mode, you must configure a *Management Interface* to control your Layer 2 communications.

When you are operating the Cisco WLAN Solution in Layer 3 mode, you must configure a *Management Interface* to control your Layer 2 communications, and an *AP-Manager Interface* to control Cisco 1000 Series lightweight access point-to-Cisco Wireless LAN Controller Layer 3 communications.

About Radio Resource Management (RRM)

Radio Resource Management (also known as RRM) allows Cisco Wireless LAN Controllers to continually monitor their associated Cisco 1000 Series lightweight access points for the following information:

- Traffic Load -- How much total bandwidth is used for transmitting and receiving traffic. This allows WLAN managers to track and plan network growth ahead of client demand.
- Interference -- How much traffic is coming from other 802.11 sources.
- Noise -- How much non-802.11 noise is interfering with the currently-assigned channel.
- Coverage -- Received Signal Strength (RSSI) and Signal to Noise Ratio (SNR) for all clients.
- Nearby access points.

Using the collected information, Radio Resource Management can periodically reconfigure the 802.11 RF network within operator-defined limits for best efficiency. To do this, Radio Resource Management:

- Dynamically reassigns channels to increase capacity and performance, both within the same Cisco Wireless LAN Controller and across multiple Cisco Wireless LAN Controllers.
- Adjusts the transmit power to balance coverage and capacity, both within the same Cisco Wireless LAN Controller and across multiple Cisco Wireless LAN Controllers.
- Allows the operator to assign nearby Cisco 1000 Series lightweight access points into groups to streamline Radio Resource Management algorithm processing.
- As new clients associate, they are load balanced across grouped Cisco 1000 Series lightweight access points reporting to each Cisco Wireless LAN Controller. This is particularly important when many clients converge in one spot (such as a conference room or auditorium), because Radio Resource Management can automatically force some subscribers to associate with nearby access points, allowing higher throughput for all clients.
- Automatically detects and configures new Cisco 1000 Series lightweight access points as they are added to the network. Radio Resource Management automatically adjusts nearby Cisco 1000 Series lightweight access points to accommodate the increased coverage and capacity.
- Automatically detects and configures new Cisco Wireless LAN Controllers as they are added to the network. The Radio Resource Management automatically distributes associated Cisco 1000 Series lightweight access points to maximize coverage and capacity.
- Detects and reports coverage holes, where clients consistently connect to a Cisco 1000 Series lightweight access point at a very low signal strength.
- Automatically defines Cisco Wireless LAN Controller Groups within operator-defined Mobility Groups.

The Radio Resource Management solution thus allows the operator to avoid the costs of laborious historical data interpretation and individual Cisco 1000 Series IEEE 802.11a/b/g lightweight access point reconfiguration. The power control features of Radio Resource Management ensure client satisfaction, and the coverage hole detection feature can alert the operator to the need for an additional (or relocated) Cisco 1000 Series lightweight access point.

Note that the Radio Resource Management uses separate monitoring and control for each of the deployed networks: 802.11a and 802.11b/802.11g. Also note that Radio Resource Management is automatically enabled, but can be customized or disabled for individual Cisco 1000 Series lightweight access points.

Finally, for operators requiring easy manual configuration, the Radio Resource Management can recommend the best Cisco Radio settings, and then assign them on operator command.

The Radio Resource Management controls produce a network that has optimal capacity, performance, and reliability. The Radio Resource Management functions also free the operator from having to contin-

ually monitor the network for noise and interference problems, which can be transient and difficult to troubleshoot. Finally, Radio Resource Management controls ensure that clients enjoy a seamless, trouble-free connection through the Cisco WLAN Solution 802.11 network.

About the Master Cisco Wireless LAN Controller

When you are adding Cisco 1000 Series lightweight access points to a *Multiple-Cisco Wireless LAN Controller Deployments* network, it is convenient to have all Cisco 1000 Series lightweight access points associate with one Master Cisco Wireless LAN Controller on the same subnet. That way, the operator does not have to log into multiple Cisco Wireless LAN Controllers to find out which Cisco Wireless LAN Controller newly-added Cisco 1000 Series lightweight access points associated with.

One Cisco Wireless LAN Controller in each subnet can be assigned as the Master Cisco Wireless LAN Controller while adding Cisco 1000 Series lightweight access points. As long as a Master Cisco Wireless LAN Controller is active on the same subnet, all new Cisco 1000 Series lightweight access points without a *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller* assigned automatically attempt to associate with the Master Cisco Wireless LAN Controller. This process is described in *Cisco Wireless LAN Controller Failover Protection*.

The operator can monitor the Master Cisco Wireless LAN Controller using the *Web User Interface* or the *Cisco Wireless Control System* GUI, and watch as Cisco 1000 Series lightweight access points associate with the Master Cisco Wireless LAN Controller. The operator can then verify Cisco 1000 Series lightweight access point configuration and assign a *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller* to the Cisco 1000 Series lightweight access point, and reboot the Cisco 1000 Series lightweight access point so it reassociates with its Primary, Secondary, or Tertiary Cisco Wireless LAN Controller.

> **Note:** Cisco 1000 Series lightweight access points without a *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller* assigned always search for a Master Cisco Wireless LAN Controller first upon reboot. After adding Cisco 1000 Series lightweight access points through the Master Cisco Wireless LAN Controller, assign Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers to each Cisco 1000 Series lightweight access point.
>
> Cisco WLAN Solution recommends that you disable the Master setting on all Cisco Wireless LAN Controllers after initial configuration.
>
> Because the Master Cisco Wireless LAN Controller is normally not used in a deployed network, the Master Cisco Wireless LAN Controller setting is automatically disabled upon reboot or OS code upgrade.

About the Primary, Secondary, and Tertiary Cisco Wireless LAN Controller

In *Multiple-Cisco Wireless LAN Controller Deployments* networks, Cisco 1000 Series lightweight access points can associate with any Cisco Wireless LAN Controller on the same subnet. To ensure that each Cisco 1000 Series lightweight access point associates with a particular Cisco Wireless LAN Controller, the operator can assign Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers to the Cisco 1000 Series lightweight access point.

When a Cisco 1000 Series lightweight access point is added to a network, it looks for its Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers first, then a *Master Cisco Wireless LAN Controller*, then the least-loaded Cisco Wireless LAN Controller with available Cisco 1000 Series lightweight access point ports. Refer to *Cisco Wireless LAN Controller Failover Protection* for more information.

About Client Roaming

The Cisco WLAN Solution supports seamless client roaming across Cisco 1000 Series lightweight access points managed by the same Cisco Wireless LAN Controller, between Cisco Wireless LAN Controllers in the same *Cisco WLAN Solution Mobility Group* on the same subnet, and across Cisco Wireless LAN Controllers in the same Mobility Group on different subnets. The following chapters describe the three modes of roaming supported by the Cisco WLAN Solution.

Same-Cisco Wireless LAN Controller (Layer 2) Roaming

Each Cisco Wireless LAN Controller supports same-Cisco Wireless LAN Controller client roaming across Cisco 1000 Series lightweight access points managed by the same Cisco Wireless LAN Controller. This roaming is transparent to the client, as the session is sustained and the client continues using the same DHCP-assigned or client-assigned IP Address. The Cisco Wireless LAN Controller provides DHCP functionality be providing a relay function. Same-Cisco Wireless LAN Controller roaming is supported in *Single-Cisco Wireless LAN Controller Deployments* and *Multiple-Cisco Wireless LAN Controller Deployments*.

Inter-Cisco Wireless LAN Controller (Layer 2) Roaming

Similarly, in *Multiple-Cisco Wireless LAN Controller Deployments*, the Cisco WLAN Solution supports client roaming across Cisco 1000 Series lightweight access points managed by Cisco Wireless LAN Controllers in the same mobility group and on the same subnet. This roaming is also transparent to the client, as the session is sustained and a tunnel between Cisco Wireless LAN Controllers allows the client to continue using the same DHCP- or client-assigned IP Address as long as the session remains active. Note that the tunnel is torn down and the client must reauthenticate when the client sends a DHCP Discover with a 0.0.0.0 client IP Address or a 169.254.*.* client auto-IP Address, or when the operator-set session timeout is exceeded.

Note that the Cisco 1030 remote edge lightweight access points at a remote location must be on the same subnet to support roaming.

Inter-Subnet (Layer 3) Roaming

Similarly, in *Multiple-Cisco Wireless LAN Controller Deployments*, the Cisco WLAN Solution supports client roaming across Cisco 1000 Series lightweight access points managed by Cisco Wireless LAN Controllers in the same mobility group on different subnets. This roaming is transparent to the client, because the session is sustained and a tunnel between the Cisco Wireless LAN Controllers allows the client to continue using the same DHCP-assigned or client-assigned IP Address as long as the session remains active. Note that the tunnel is torn down and the client must reauthenticate when the client sends a DHCP Discover with a 0.0.0.0 client IP Address or a 169.254.*.* client auto-IP Address, or when the operator-set session timeout is exceeded.

Note that the Cisco 1030 remote edge lightweight access points at a remote location must be on the same subnet to support roaming.

Special Case: Voice Over IP Telephone Roaming

802.11 VoIP telephones actively seek out associations with the strongest RF signal to ensure best Quality of Service (QoS) and maximum throughput. The minimum VoIP telephone requirement of 20 millisecond or shorter latency time for the roaming handover is easily met by the Cisco WLAN Solution, which has an average handover latency of nine or fewer milliseconds.

This short latency period is controlled by Cisco Wireless LAN Controllers, rather than allowing independent access points to negotiate roaming handovers.

The Cisco WLAN Solution supports 802.11 VoIP telephone roaming across Cisco 1000 Series lightweight access points managed by Cisco Wireless LAN Controllers on different subnets, as long as the Cisco Wireless LAN Controllers are in the same mobility group. This roaming is transparent to the VoIP telephone, because the session is sustained and a tunnel between Cisco Wireless LAN Controllers allows the

VoIP telephone to continue using the same DHCP-assigned IP Address as long as the session remains active. Note that the tunnel is torn down and the VoIP client must reauthenticate when the VoIP telephone sends a DHCP Discover with a 0.0.0.0 VoIP telephone IP Address or a 169.254.*.* VoIP telephone auto-IP Address, or when the operator-set session timeout is exceeded.

About Client Location

The Cisco WLAN Solution periodically determines client, rogue access point, rogue assess point client, radio frequency ID (RFID) tag location and stores the locations in the Cisco WCS database. To view the client location history, display the Cisco WCS Monitor Client <client> - <vendor:MACaddr> page and select Recent Map (High Resolution) or Present Map (High Resolution). *Cisco WCS Base* supports location to the nearest Cisco 1000 Series lightweight access point. *Cisco WCS Location* supports location to within 10 meters.

When Cisco WCS Location is used, Cisco WLAN Solution end users can also deploy Cisco 2700 Series Location Appliances (location appliances), described in the *Cisco 2700 Series Location Appliances* section. The location appliance enhances the high-accuracy built-in Cisco WCS Location abilities by computing, collecting and storing historical location data, which can be displayed in Cisco WCS. In this role, the location appliance acts as a server to one or more Cisco WCS Servers, collecting, storing, and passing on data from its associated Cisco Wireless LAN Controllers.

About External DHCP Servers

The Operating System is designed to appear as a DHCP Relay to the network and as a DHCP Server to clients with industry-standard external DHCP Servers that support DHCP Relay. This means that each Cisco Wireless LAN Controller appears as a DHCP Relay agent to the DHCP Server. This also means that the Cisco Wireless LAN Controller appears as a DHCP Server at the virtual IP Address to wireless clients.

Because the Cisco Wireless LAN Controller captures the client IP Address obtained from a DHCP Server, it maintains the same IP Address for that client during same-Cisco Wireless LAN Controller, inter-Cisco Wireless LAN Controller, and inter-subnet *Client Roaming*.

Per-WLAN Assignment

All *Cisco WLAN Solution WLANs* can be configured to use the same or different DHCP Servers, or no DHCP Server. This allows operators considerable flexibility in configuring their Wireless LANs, as further described in the *Cisco WLAN Solution WLANs* section.

Note that Cisco WLAN Solution WLANs that support *Management over Wireless* must allow the management (device servicing) clients to obtain an IP Address from a DHCP Server.

Per-Interface Assignment

- The Layer 2 *Management Interface* can be configured for a primary and secondary DHCP server.
- The Layer 3 *AP-Manager Interface* can be configured for a primary and secondary DHCP server.
- Each of the *Operator-Defined Interfaces* can be configured for a primary and secondary DHCP server.
- The *Virtual Interface* does not use DHCP servers.
- The *Service-Port Interface* can be configured to enable or disable DHCP servers.

Security Considerations

For enhanced security, it is recommended that operators require all clients to obtain their IP Addresses from a DHCP server. To enforce this requirement, all *Cisco WLAN Solution WLANs* can be configured with a 'DHCP Required' setting and a valid DHCP Server IP Address, which disallows client static IP Addresses. If a client associating with a WLAN with 'DHCP Required' set does not obtain its IP Address from the designated DHCP Server, it is not allowed access to any network services.

Note that if 'DHCP Required' is selected, clients must obtain an IP address via DHCP. Any client with a static IP address will not be allowed on the network. The Cisco Wireless LAN Controller monitors DHCP traffic since it acts as a DHCP proxy for the clients.

If slightly less security is tolerable, operators can create *Cisco WLAN Solution WLANs* with 'DHCP Required' disabled and a valid DHCP Server IP Address. Clients then have the option of using a static IP Address or obtaining an IP Address from the designated DHCP Server.

Operators are also allowed to create separate *Cisco WLAN Solution WLANs* with 'DHCP Required' disabled and a DHCP Server IP Address of 0.0.0.0. These WLANs drop all DHCP requests and force clients to use a static IP Address. Note that these WLANs do not support *Management over Wireless*.

About Cisco WLAN Solution Mobility Groups

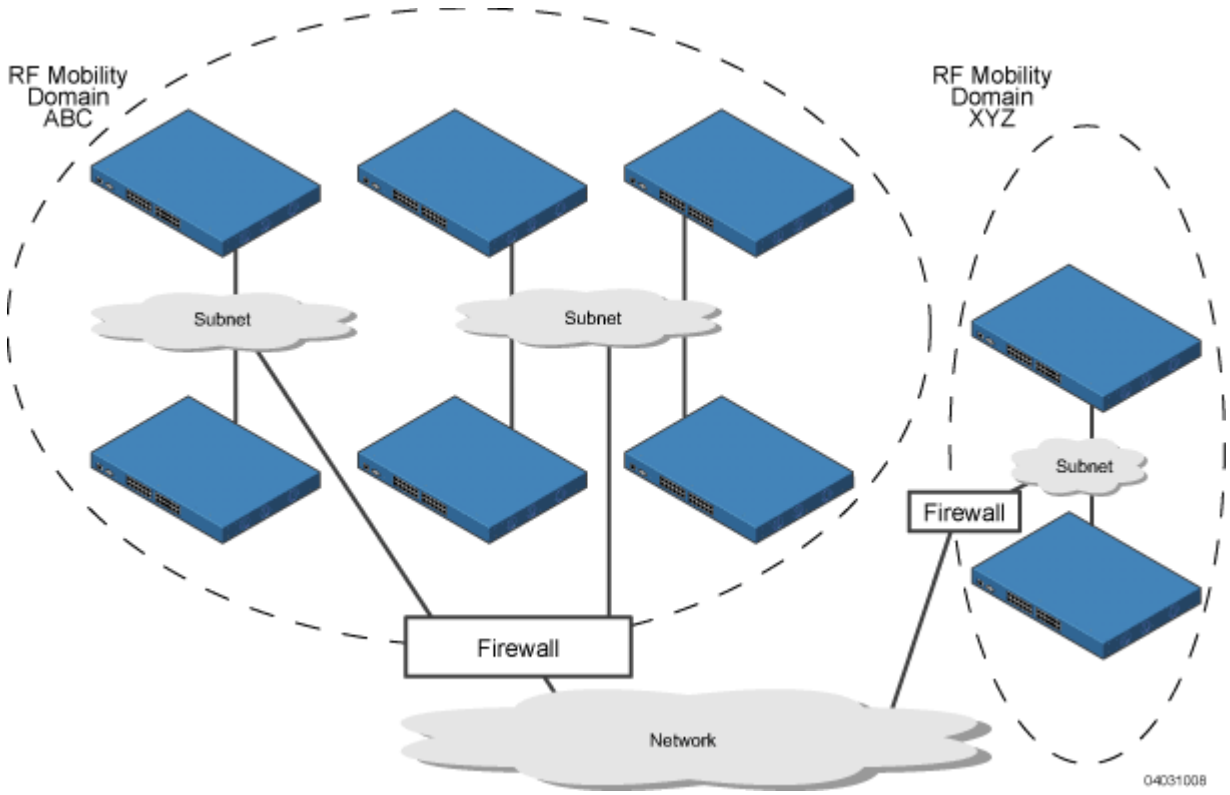
Cisco WLAN Solution operators can define Mobility Groups to allow client roaming across groups of Cisco Wireless LAN Controllers. Because the Cisco Wireless LAN Controllers in *Multiple-Cisco Wireless LAN Controller Deployments* can detect each other across the network and over the air, it is important that each enterprise, institution, and wireless internet service provider isolate their Cisco Wireless LAN Controllers. The Operating System makes it easy for operators to create this isolation by allowing them to assign a Mobility Group Name to their Cisco Wireless LAN Controllers. This assignment can be made using the *Web User Interface*, the *Cisco Wireless Control System*, or the *Command Line Interface*.

Before clients can roam, they are automatically associated with their original, or anchor, Cisco Wireless LAN Controller. This anchor Cisco Wireless LAN Controller maintains the client information and ensures that the client remains connected with the same IP address across all handoffs for the duration of the client session.

Note that all the Cisco Wireless LAN Controllers in a Mobility Group must use the same LWAPP *Layer 2 and Layer 3 LWAPP Operation*, or you will defeat the Mobility software algorithm.

The following figure shows the results of creating Mobility Group Names for two groups of Cisco Wireless LAN Controllers. The Cisco Wireless LAN Controllers in the ABC Mobility Group recognize and communicate with each other through their *Cisco 1000 Series Lightweight Access Points* and through their shared subnets, but the ABC Mobility Group tags the XYZ Cisco 1000 Series lightweight access points as *Rogue Access Points*. Likewise, the Cisco Wireless LAN Controllers in the XYZ Mobility Group do not recognize or communicate with the Cisco Wireless LAN Controllers in the ABC Mobility Group. This feature ensures Mobility Group isolation across the network.

Figure - Typical Cisco WLAN Solution Mobility Group Name Application



CAUTION: Cisco recommends that you assign one set of VLANs for WLANs and a different set of VLANs for Management Interfaces to ensure that Cisco Wireless LAN Controllers properly route VLAN traffic.

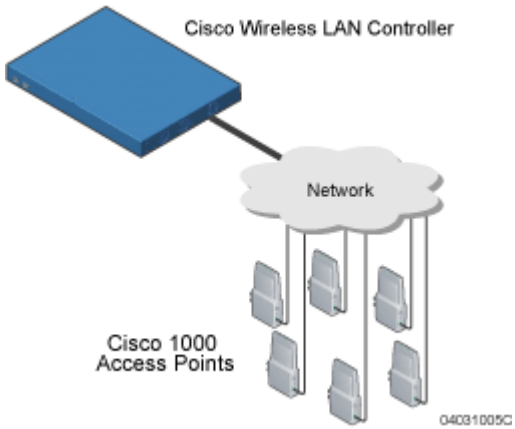
The Cisco WLAN Solution Mobility Group feature can also be used to limit roaming between different floors, buildings, or campuses in the same enterprise by assigning different Mobility Group names to different Cisco Wireless LAN Controllers within the same wireless network.

If enabled, *Radio Resource Management (RRM)* operation is constrained within each Cisco WLAN Solution Mobility Group.

Note: Because the Cisco Wireless LAN Controllers talk to each other when they are in the same mobility group, Cisco WLAN Solution recommends that operators do not add physically-separated Cisco Wireless LAN Controllers to the same static mobility group to avoid unnecessary traffic on the network.

About Cisco WLAN Solution Wired Connections

The Cisco WLAN Solution components communicate with each other using industry-standard Ethernet cables and connectors. The following paragraphs contain details of the Cisco WLAN Solution wired connections.



- The Cisco 2000 Series Wireless LAN Controller connects to the network using between one and four 10/100BASE-T Ethernet cables.
- The Cisco 4100 Series Wireless LAN Controller connects to the network using one or two fiber-optic GigE cables: two redundant GigE connections to bypass single network failures. At any given time one of the Cisco 4100 Series Wireless LAN Controller GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.
- The 4402 Cisco 4400 Series Wireless LAN Controller connects to the network using one or two two fiber-optic GigE cables, and the 4404 Cisco 4400 Series Wireless LAN Controller connects to the network using one through four fiber-optic GigE cables: two redundant GigE connections to bypass single network failures. At any given time one of each pair of Cisco 4400 Series Wireless LAN Controller GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.
- Cisco 1000 Series lightweight access points connects to the network using 10/100BASE-T Ethernet cables. The standard CAT-5 cable can also be used to conduct power for the Cisco 1000 Series lightweight access points from a network device equipped with *Power Over*

Ethernet (PoE) capability. This power distribution plan can be used to reduce the cost of individual AP power supplies and related cabling.

About Cisco WLAN Solution WLANs

The Cisco WLAN Solution can control up to 16 Wireless LANs for *Cisco 1000 Series Lightweight Access Points*. Each WLAN has a separate WLAN ID (1 through 16), a separate WLAN SSID (WLAN Name), and can be assigned unique security policies.

The Cisco 1000 Series lightweight access points broadcast all active Cisco WLAN Solution WLAN SSIDs and enforce the policies defined for each WLAN.

CAUTION: Cisco recommends that you assign one set of VLANs for WLANs and a different set of VLANs for Management Interfaces to ensure that Cisco Wireless LAN Controllers properly route VLAN traffic.

If *Management over Wireless* is enabled across Cisco WLAN Solution, the Cisco WLAN Solution operator can manage the System across the enabled WLAN using CLI and Telnet (*Command Line Interface*), http/https (*Web User Interface*), and SNMP (*Cisco Wireless Control System*).

To configure the Cisco WLAN Solution WLANs, refer to *Configuring WLANs*.

About Access Control Lists

The Operating System allows you to define up to 64 Access Control Lists (ACLs), similar to standard firewall Access Control Lists. Each ACL can have up to 64 Rules (filters).

Operators can use ACLs to control client access to multiple VPN servers within a given WLAN. If all the clients on a WLAN must access a single VPN server, use the IPSec/VPN Gateway Passthrough setting in the *IPSec Passthrough* section.

After they are defined, the ACLs can be applied to the *Management Interface*, the *AP-Manager Interface*, or any of the *Operator-Defined Interfaces*.

Refer to Access Control Lists > New in the Web User Interface Online Help or *Creating Access Control Lists* in the *Configuring the Cisco Wireless LAN Controller* sections for instructions on how to configure the Access Control Lists.

About Identity Networking

Cisco Wireless LAN Controllers can have the following parameters applied to all clients associating with a particular WLAN: QoS, global or Interface-specific DHCP server, Layer 2 and Layer 3 Security Policies, and default Interface (which includes physical port, VLAN and ACL assignments).

However, the Cisco Wireless LAN Controller can also have individual clients (MAC addresses) override the preset WLAN parameters by using MAC Filtering or by Allowing AAA Override parameters. This configuration can be used, for example, to have all company clients log into the corporate WLAN, and then have clients connect using different QoS, DHCP server, Layer 2 and Layer 3 Security Policies, and Interface (which includes physical port, VLAN and ACL assignments) settings on a per-MAC Address basis.

When Cisco WLAN Solution operators configure MAC Filtering for a client, they can assign a different VLAN to the MAC Address, which can be used to have OS automatically reroute the client to the *Management Interface* or any of the *Operator-Defined Interfaces*, each of which have their own VLAN, ACL, DHCP server, and physical port assignments. This MAC Filtering can be used as a coarse version of AAA Override, and normally takes precedence over any AAA (RADIUS or other) Override.

However, when Allow AAA Override is enabled, the RADIUS (or other AAA) server can alternatively be configured to return QoS and ACL on a per-MAC Address basis. Allow AAA Override gives the AAA Override precedence over the MAC Filtering parameters set in the Cisco Wireless LAN Controller; if there are no AAA Overrides available for a given MAC Address, the OS uses the MAC Filtering parameters already in the Cisco Wireless LAN Controller. This AAA (RADIUS or other) Override can be used as a finer version of AAA Override, but only takes precedence over MAC Filtering when Allow AAA Override is enabled.

Note that in all cases, the Override parameters (Operator-Defined Interface and QoS, for example) must already be defined in the Cisco Wireless LAN Controller configuration.

In all cases, the OS will use QoS and ACL provided by the AAA server or MAC Filtering regardless of the Layer 2 and/or Layer 3 authentication used.

Also note that the OS will only move clients from the default Cisco WLAN Solution WLAN VLAN to a different VLAN when configured for MAC filtering, 802.1X, and/or WPA Layer 2 authentication.

To configure the Cisco WLAN Solution WLANs, refer to *Configuring WLANs*.

About File Transfers

The Cisco WLAN Solution operator can upload and download Operating System code, configuration, and certificate files to and from a Cisco Wireless LAN Controller using CLI commands, Web User Interface commands, or Cisco Wireless Control System (Cisco WCS) commands.

- To use CLI commands, refer to *Transferring Files To and From a Cisco Wireless LAN Controller*.
- To use the Web User Interface, go to *Using the Web User Interface*.
- To use Cisco WCS commands, continue with *Using the Cisco Wireless Control System*.

About Power Over Ethernet

Cisco 1000 Series Lightweight Access Points can receive power via their ethernet cables from 802.3af-compatible Power over Ethernet (PoE) devices, which can reduce the cost of discrete power supplies, additional wiring, conduits, outlets, and installer time. PoE also frees installers from having to mount Cisco 1000 Series lightweight access points or other powered equipment near AC outlets, providing greater flexibility in positioning Cisco 1000 Series lightweight access points for maximum coverage.

When you are using PoE, the installer runs a single CAT-5 cable from each Cisco 1000 Series lightweight access point to PoE-equipped network elements, such as a PoE power hub or a Cisco WLAN Solution Single-Line PoE Injector, described in *Cisco 1000 Series Lightweight Access Point Part Numbers*. When the PoE equipment determines that the Cisco 1000 Series lightweight access point is PoE-enabled, it sends 48 VDC over the unused pairs in the Ethernet cable to power the Cisco 1000 Series lightweight access point.

The PoE cable length is limited by the 100BASE-T or 10BASE-T specification to 100 m or 200 m, respectively.

Note: Cisco 1000 Series lightweight access points can receive power from any network device conforming to the IEEE 802.3af standard.

Note: Each Cisco 1000 Series lightweight access point can alternatively receive power from an *Cisco 1000 Series Lightweight Access Point External Power Supply*.

Pico Cell Functionality

Pico Cell functionality includes optimization of the Operating System (OS) to support this functionality as follows:

- The Cisco WCS Pico Cell Mode parameter reconfigures OS parameters, allowing OS to function efficiently in pico cell deployments. Note that when the operator is deploying a pico cell network the OS must also have more memory allocated (512 to 2048 MB) using the **`config database size 2048`** CLI command.
- Client mobility between multiple mobility domains when such exist.
- Addition of a WPA2 VFF extension to eliminate the need to re-key after every association. This allows the re-use of existing PTK and GTK.
- With WPA2 PMK caching and VFF, the PMK cache is transferred as part of context transfer prior to the authentication phase. This allows expedited handoffs to work for both intra- and inter-Cisco Wireless LAN Controller roaming events.
- A beacon/probe response that allows a Cisco 1000 Series lightweight access point to indicate which Cisco Wireless LAN Controller it is attached to so that reauthorization events only occur when needed, minimizing inter-Cisco Wireless LAN Controller handoffs and thus reducing CPU usage.
- Allows changes to Cisco 1000 Series lightweight access point sensitivity for pico cells.
- Allows control of Cisco 1000 Series lightweight access point fallback behavior to optimize pico cell use.
- Supports heat maps for directional antennas.
- Allows specific control over blacklisting events
- Allows configuring and viewing basic LWAPP configuration using the Cisco 1000 Series light-weight access point CLI.

Intrusion Detection Service (IDS)

Intrusion Detection Service includes the following:

- Sensing Clients probing for “ANY” SSID
- Sensing if Cisco 1000 Series lightweight access points are being contained
- Notification of MiM Attacks, NetStumbler, Wellenreiter
- Management Frame Detection and RF Jamming Detection
- Spoofed Deauthentication Detection (AirJack, for example)
- Broadcast Deauthorization Detection
- Null Probe Response Detection
- Fake AP Detection
- Detection of Weak WEP Encryption
- MAC Spoofing Detection
- AP Impersonation Detection
- Honeypot AP Detection
- Valid Station Protection
- Misconfigured AP Protection
- Rogue Access Point Detection
- AD-HOC Detection and Protection
- Wireless Bridge Detection
- Asleep Detection / Protection

About Cisco Wireless LAN Controllers

Cisco Wireless LAN Controllers are enterprise-class high-performance wireless switching platforms that support 802.11a and 802.11b/802.11g protocols. They operate under control of the Operating System, which includes the Radio Resource Management (RRM), creating a Cisco WLAN Solution that can automatically adjust to real-time changes in the 802.11 RF environment. The Cisco Wireless LAN Controllers are built around high-performance network and security hardware, resulting in highly-reliable 802.11 enterprise networks with unparalleled security. Also see:

- *Cisco 2000 Series Wireless LAN Controllers*
- *Cisco 4100 Series Wireless LAN Controllers*
- *Cisco 4400 Series Wireless LAN Controllers*
- *Cisco 2000 Series Wireless LAN Controller Model Numbers*
- *Cisco 4100 Series Wireless LAN Controller Model Numbers*
- *Cisco 4400 Series Wireless LAN Controller Model Numbers*
- *Distribution System Ports*
- *Management Interface*
- *AP-Manager Interface*
- *Operator-Defined Interfaces*
- *Virtual Interface*
- *Service Port*
- *Service-Port Interface*
- *Startup Wizard*
- *Cisco Wireless LAN Controller Memory*
- *Cisco Wireless LAN Controller Failover Protection*
- *Cisco Wireless LAN Controller Automatic Time Setting*
- *Cisco Wireless LAN Controller Time Zones*
- *Network Connections to Cisco Wireless LAN Controllers*
- *Cisco 4100 Series Wireless LAN Controller VPN/Enhanced Security Module*

Cisco 2000 Series Wireless LAN Controllers

The Cisco 2000 Series Wireless LAN Controller is part of the Cisco WLAN Solution. Each Cisco 2000 Series Wireless LAN Controller controls up to six Cisco 1000 Series lightweight access points, making it ideal for smaller enterprises and low-density applications. *About the Cisco Wireless LAN Solution* gives a comprehensive overview of the Cisco WLAN Solution and the place of the Cisco 2000 Series Wireless LAN Controller in that system.

The Cisco 2000 Series Wireless LAN Controller is a slim 9.5 x 6.0 x 1.6 in. (241 x 152 x 41 mm) chassis that can be desktop or shelf mounted. The Cisco 2000 Series Wireless LAN Controller front panel has one POWER LED and four sets of Ethernet LAN Port status LEDs, which indicate 10 MHz or 100 MHz connections and transmit/receive Activity for the four corresponding back-panel Ethernet LAN connectors. The Cisco 2000 Series Wireless LAN Controller is shipped with four rubber desktop/shelf mounting feet.

Cisco 4100 Series Wireless LAN Controllers

The Cisco 4100 Series Wireless LAN Controllers are part of the Cisco WLAN Solution. Each Cisco 4100 Series Wireless LAN Controller controls up to 36 Cisco 1000 Series lightweight access points, making it ideal for medium-sized enterprises and medium-density applications.

The *About the Cisco Wireless LAN Solution* gives a comprehensive overview of the Cisco WLAN Solution and the place of the Cisco 4100 Series Wireless LAN Controller in that system.

The following figure shows the Cisco 4100 Series Wireless LAN Controller, which has two redundant front-panel SX/LC jacks. Note that the 1000BASE-SX circuits provides a 100/1000 Mbps wired connection to a network through an 850nM (SX) fiber-optic link using an LC physical connector.

Figure - Cisco 4100 Series Wireless LAN Controller

The Cisco 4100 Series Wireless LAN Controller can be factory-ordered with a VPN/Enhanced Security Module (Crypto Card) to support VPN, IPSec and other processor-intensive tasks, and contains two (Cisco 4100 Series Wireless LAN Controller) 1000BASE-SX network connectors that allow the Cisco 4100 Series Wireless LAN Controller to communicate with the network at GigE (Gigabit Ethernet) speeds. The 1000BASE-SX network connectors provides 100/1000 Mbps wired connections to a network through 850nM (SX) fiber-optic links using LC physical connectors.

The two redundant GigE connections on the Cisco 4100 Series Wireless LAN Controller allow the Cisco 4100 Series Wireless LAN Controller to bypass single network failures. At any given time one of the Cisco 4100 Series Wireless LAN Controller GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.

Cisco 4400 Series Wireless LAN Controllers

Cisco 4400 Series Wireless LAN Controllers are part of the Cisco WLAN Solution. Each Cisco 4400 Series Wireless LAN Controller controls up to 100 Cisco 1000 Series lightweight access points, making it ideal for large-sized enterprises and large-density applications.

The *About the Cisco Wireless LAN Solution* gives a comprehensive overview of the Cisco WLAN Solution and the place of the Cisco 4400 Series Wireless LAN Controller in that system.

The 4402 Cisco 4400 Series Wireless LAN Controller has one set of two redundant front-panel SX/LC/T SFP modules (SFP transceiver, or Small Form-factor Plug-in), and the 4404 Cisco 4400 Series Wireless LAN Controller has two sets of two redundant front-panel SX/LC/T SFP modules:

- 1000BASE-SX SFP modules provide a 1000 Mbps wired connection to a network through an 850nM (SX) fiber-optic link using an LC physical connector.
- 1000BASE-LX SFP modules provide a 1000 Mbps wired connection to a network through a 1300nM (LX/LH) fiber-optic link using an LC physical connector.
- 1000BASE-T SFP modules provide a 1000 Mbps wired connection to a network through a copper link using an RJ-45 physical connector.

The one or two sets of redundant GigE connections on the Cisco 4400 Series Wireless LAN Controller allow the Cisco 4400 Series Wireless LAN Controller to bypass single network failures. At any given time one of the Cisco 4400 Series Wireless LAN Controller GigE connections is active and the other is

passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.

The Cisco 4400 Series Wireless LAN Controller can be equipped with one or two Cisco 4400 series power supplies. When the Cisco Wireless LAN Controller is equipped with two Cisco 4400 series power supplies, the power supplies are redundant and either power supply can continue to power the Cisco 4400 Series Wireless LAN Controller if the other power supply fails.

One Cisco 4400 series power supply is included standard with the Cisco Wireless LAN Controller, and is installed in Slot 1 at the factory. For redundancy, a second Cisco 4400 series power supply can be ordered from the factory and may be installed in Slot 2. The same power supply also fits in Slot 1 and can be used to replace a failed power supply in the field.

Cisco 2000 Series Wireless LAN Controller Model Numbers

Cisco 2000 Series Wireless LAN Controller model number is as follows:

- AIR-WLC2006-K9 - The Cisco 2000 Series Wireless LAN Controller communicates with up to six Cisco 1000 Series lightweight access points.

Note that the Cisco 2000 Series Wireless LAN Controllers come from the factory with tabletop mounting feet.

Cisco 4100 Series Wireless LAN Controller Model Numbers

Cisco 4100 Series Wireless LAN Controller model numbers are as follows:

- AIR-WLC4112-K9 - The Cisco 4100 Series Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 12 Cisco 1000 Series lightweight access points. That is, at any given time one of the Cisco 4100 Series Wireless LAN Controller GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active. Note that the 1000BASE-SX Network Adapters provide 100/1000 Mbps wired connections to a network through 850nM (SX) fiber-optic links using LC physical connectors.
- AIR-WLC4124-K9 - The Cisco 4100 Series Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 24 Cisco 1000 Series lightweight access points.
- AIR-WLC4136-K9 - The Cisco 4100 Series Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 36 Cisco 1000 Series lightweight access points.

Note that all Cisco 4100 Series Wireless LAN Controller models come from the factory with 19-inch EIA equipment rack flush-mount ears.

The following upgrade module is also available:

- AIR-VPN-4100 - VPN/Enhanced Security Module: Supports VPN, L2TP, IPSec and other processor-intensive security options. This is a field-installable option for all Cisco 4100 Series Wireless LAN Controllers.

Cisco 4400 Series Wireless LAN Controller Model Numbers

Cisco 4400 Series Wireless LAN Controller model numbers are as follows:

- AIR-WLC4402-12-K9 - The 4402 Cisco 4400 Series Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 12 Cisco 1000 Series lightweight access points. That is, at any given time one of the Cisco 4400 Series

Wireless LAN Controller GigE connections is active and the other is passive. Upon a network failure, the active connection becomes passive, and the passive connection becomes active.

- AIR-WLC4402-25-K9 - The 4402 Cisco Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 25 Cisco 1000 Series lightweight access points.
- AIR-WLC4402-50-K9 - The 4402 Cisco Wireless LAN Controller uses two redundant GigE connections to bypass single network failures, and communicates with up to 50 Cisco 1000 Series lightweight access points.
- AIR-WLC4404-100-K9 - The 4404 Cisco Wireless LAN Controller uses four redundant GigE connections to bypass one or two single network failures, and communicates with up to 100 Cisco 1000 Series lightweight access points.

Note that all Cisco 4400 Series Wireless LAN Controller models come from the factory with integral 19-inch EIA equipment rack flush-mount ears.

The 4402 Cisco 4400 Series Wireless LAN Controller uses one set of two redundant front-panel SX/LC/T SFP modules (SFP transceiver, or Small Form-factor Plug-in), and the 4404 Cisco 4400 Series Wireless LAN Controller uses two sets of two redundant front-panel SX/LC/T SFP modules:

- 1000BASE-SX SFP modules provide a 1000 Mbps wired connection to a network through an 850nM (SX) fiber-optic link using an LC physical connector.
- 1000BASE-LX SFP modules provide a 1000 Mbps wired connection to a network through a 1300nM (LX/LH) fiber-optic link using an LC physical connector.
- 1000BASE-T SFP modules provide a 1000 Mbps wired connection to a network through a copper link using an RJ-45 physical connector.

The following power supply module is also available:

- AIR-PWR-4400-AC - All Cisco 4400 series power supplies. One Cisco 4400 series power supply can power Cisco 4400 series power supplies can power Cisco 4400 series power supplies, the Cisco 4400 series power supplies are redundant.

About Distribution System Ports

A Distribution System (DS) port is a physical port (see *Cisco WLAN Solution Wired Connections*) through which a Cisco Wireless LAN Controller talks to Cisco 1000 Series lightweight access points via the network. DS Ports are where packets are exchanged between the Cisco WLAN Solution WLANs and the rest of the network.

> **Note:** The Distribution System Port cannot be assigned to a dedicated Cisco Wireless LAN Controller *Service Port*.

As described in *Layer 2 and Layer 3 LWAPP Operation*, when the LWAPP communications are set to Layer 2 (same subnet) operation, the Distribution System must have one *Management Interface* to control all inter-Cisco Wireless LAN Controller and all Cisco Wireless LAN Controller-to-Cisco 1000 Series lightweight access point communications, regardless of the number of physical Distribution System ports.

Also as described in *Layer 2 and Layer 3 LWAPP Operation*, when the LWAPP communications are set to Layer 3 (different subnet) operation, the Distribution System must have one *Management Interface* to control all inter-Cisco Wireless LAN Controller communications, and must have one *AP-Manager Interface* to control all Cisco Wireless LAN Controller-to-Cisco 1000 Series lightweight access point communications, regardless of the number of physical Distribution System ports.

Each physical Distribution System port can also have between one and 512 *Operator-Defined Interfaces* assigned to it. Each Operator-Defined Interface is individually configured, and allows VLAN communications to exist on the Distribution System port(s).

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About the Management Interface

The logical Management Interface controls Layer 2 communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points.

> **CAUTION:** Cisco recommends that you assign one set of VLANs for WLANs and a different set of VLANs for Management Interfaces to ensure that Cisco Wireless LAN Controllers properly route VLAN traffic.

The Management Interface is assigned to one physical port (*Cisco WLAN Solution Wired Connections*), through which it communicates with other network devices and other access points. However, the Management Interface can also communicate through all other physical ports except the *Service Port* as follows:

- Sends messages through the Layer 2 network to autodiscover and communicate with other Cisco Wireless LAN Controllers through all physical ports except the *Service Port*.
- Listens across the Layer 2 network for Cisco 1000 Series lightweight access point LWAPP polling messages to autodiscover, associate with, and communicate with as many Cisco 1000 Series lightweight access points as it can.

> **Note:** Should a Cisco Wireless LAN Controller fail, its dropped Cisco 1000 Series lightweight access points poll the network for another Cisco Wireless LAN Controller. When an online Cisco Wireless LAN Controller has any remaining Cisco 1000 Series lightweight access point ports, the Management Interface listens to the network for Cisco 1000 Series lightweight access point polling messages to autodiscover, associate with, and communicate with as many Cisco 1000 Series lightweight access points as it can. Refer to the *Cisco Wireless LAN Controller Failover Protection* section for more information.

> **Note:** The Management Interface cannot be assigned to the dedicated Cisco Wireless LAN Controller *Service Port*.

The Management Interface uses the burned-in Cisco Wireless LAN Controller Distribution System MAC address, and must be configured for the following:

- VLAN assignment.
- Fixed IP Address, IP netmask, and default gateway.
- Physical port assignment.
- Primary and Secondary DHCP Servers.
- Access Control List, if required.

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About the AP-Manager Interface

The logical AP-Manager Interface controls Layer 3 communications between Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access points.

The AP-Manager Interface is assigned to one physical port (*Cisco WLAN Solution Wired Connections*), and can be on the same subnet and physical port as the *Management Interface*. The AP-Manager Interface can communicate through any physical port except the *Service Port* as follows:

- Sends Layer 3 messages through the network to autodiscover and communicate with other Cisco Wireless LAN Controllers.
- Listens across the network for Layer 3 Cisco 1000 Series lightweight access point LWAPP polling messages to autodiscover, associate with, and communicate with as many Cisco 1000 Series lightweight access points as it can.

  Note: Should a Cisco Wireless LAN Controller fail, its dropped Cisco 1000 Series lightweight access points poll the network for another Cisco Wireless LAN Controller. When an online Cisco Wireless LAN Controller has any remaining Cisco 1000 Series lightweight access point ports, the AP-Manager Interface listens to the network for Cisco 1000 Series lightweight access point polling messages to autodiscover, associate with, and communicate with as many Cisco 1000 Series lightweight access points as it can. Refer to the *Cisco Wireless LAN Controller Failover Protection* section for more information.

  Note: The AP-Manager Interface cannot be assigned to the dedicated Cisco Wireless LAN Controller *Service Port*.

The AP-Manager Interface must be configured for the following:

- VLAN assignment.
- Fixed IP Address (must be different than the Management Interface IP address, but must be on the same subnet as the Management Interface), IP netmask, and default gateway.
- Physical port assignment.
- Primary and Secondary DHCP Servers.
- Access Control List, if required.

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About Operator-Defined Interfaces

Each Cisco Wireless LAN Controller can support up to 512 Operator-Defined Interfaces. Each Operator-Defined Interface controls VLAN and other communications between Cisco Wireless LAN Controllers and all other network devices connected to an individual physical port. Between one and 512 Operator-Defined Interfaces can be assigned to *Cisco WLAN Solution WLANs*, physical *Distribution System Ports*, the Layer 2 *Management Interface*, and the Layer 3 *AP-Manager Interface*.

Note: Operator-Defined Interfaces cannot be assigned to the dedicated Cisco Wireless LAN Controller *Service Port*.

CAUTION: Operator-Defined Interface names cannot have spaces in them. If an Operator-Defined Interface name contains a space, you may not be able to edit its configuration using the *Command Line Interface*.

Each Operator-Defined Interface must be configured for the following:

- VLAN number.
- Fixed IP Address, IP netmask, and default gateway.
- Physical port assignment.
- Primary and Secondary DHCP Servers.
- Access Control List, if required.

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About the Virtual Interface

The Virtual Interface controls Layer 3 Security and Mobility manager communications for Cisco Wireless LAN Controllers. It maintains the DNS Gateway hostname used by Layer 3 Security and Mobility managers to verify the source of certificates when Layer 3 Web Auth is enabled.

The Virtual Interface must be configured for the following:

- Any fictitious, unassigned, unused Gateway IP Address.
- DNS Gateway Host Name.

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About the Service Port

The physical Service port on the Cisco Wireless LAN Controller is a 10/100BASE-T Ethernet port dedicated to Operating System device service, and was formerly known as the Management port. The Service Port is controlled by the *Service-Port Interface*.

The Service Port is configured with an IP Address, subnet mask, and IP assignment protocol different from the *Management Interface*. This allows the operator to manage the Cisco Wireless LAN Controller directly or through a dedicated Operating System service network, such as 10.1.2.x, which can ensure Operating System device service access during network downtime.

Cisco WLAN Solution created the Service port to remove the Cisco Wireless LAN Controller device service from the network data stream to improve security and to provide a more secure service connection.

Note that you cannot assign a Gateway to the Service port, so the port is not routable. However, you can set up dedicated routes to network management devices.

Also note that the Service Port is not auto-sensing: you must use the correct straight-through or crossover Ethernet cable to communicate with the Service Port.

Refer to the *Configuring Other Ports and Parameters* for information on how to configure the Service Port.

About the Service-Port Interface

The Service-Port Interface controls communications through the dedicated Cisco Wireless LAN Controller *Service Port*.

> **Note:** The Service-Port Interface can only be assigned to the dedicated Cisco Wireless LAN Controller *Service Port*.

The Service-Port Interface uses the burned-in Cisco Wireless LAN Controller Service Port MAC address, and must be configured for the following:

- Whether or not DHCP Protocol is activated.
- IP Address and IP netmask.

Refer to the *Configuring the Cisco Wireless LAN Controller* section for configuration instructions.

About the Startup Wizard

When an Cisco Wireless LAN Controller is powered up with a new factory Operating System software load or after being reset to factory defaults, the bootup script runs the Startup Wizard, which prompts the installer for initial configuration. The Startup Wizard:

- Ensures that the Cisco Wireless LAN Controller has a System Name, up to 32 characters.
- Adds an Administrative username and password, each up to 24 characters.
- Ensures that the Cisco Wireless LAN Controller can communicate with the CLI, Cisco WCS, or Web User interfaces (either directly or indirectly) through the *Service Port* by accepting a valid IP configuration protocol (none or DHCP), and if 'none', IP Address and netmask. If you do not want to use the Service port, enter 0.0.0.0 for the IP Address and netmask.
- Ensures that the Cisco Wireless LAN Controller can communicate with the network (802.11 Distribution System) through the *Management Interface* by collecting a valid static IP Address, netmask, default router IP address, VLAN identifier, and physical port assignment.
- Prompts for the IP address of the DHCP server used to supply IP addresses to clients, the Cisco Wireless LAN Controller Management Interface, and optionally to the Service Port Interface.
- Asks for the LWAPP Transport Mode, described in *Layer 2 and Layer 3 LWAPP Operation*.
- Collects the Virtual Gateway IP Address; any fictitious, unassigned IP address (such as 1.1.1.1) to be used by Layer 3 Security and Mobility managers.
- Allows you to enter the *Cisco WLAN Solution Mobility Group* (RF Group) Name.
- Collects the WLAN 1 802.11 SSID, or Network Name.
- Asks you to define whether or not clients can use static IP addresses. Yes = more convenient, but lower security (session can be hijacked), clients can supply their own IP Address, better for devices that cannot use DHCP. No = less convenient, higher security, clients must DHCP for an IP Address, works well for Windows XP devices.
- If you want to configure a RADIUS server from the Startup Wizard, the RADIUS server IP address, communication port, and Secret.
- Collects the Country Code. (Refer to *Cisco WLAN Solution Supported Country Codes*.)
- Enables and/or disables the 802.11a, 802.11b and 802.11g Cisco 1000 Series lightweight access point networks.
- Enables or disables *Radio Resource Management (RRM)*.

To use the Startup Wizard, refer to *Using the Startup Wizard*.

About Cisco Wireless LAN Controller Memory

The Cisco Wireless LAN Controller contain two kinds of memory: volatile RAM, which holds the current, active Cisco Wireless LAN Controller configuration, and NVRAM (non-volatile RAM), which holds the reboot configuration. When you are configuring the Operating System in a Cisco Wireless LAN Controller, you are modifying volatile RAM; you must save the configuration from the volatile RAM to the NVRAM to ensure that the Cisco Wireless LAN Controller reboots in the current configuration.

Knowing which memory you are modifying is important when you are:

- Using the *Startup Wizard*
- *Clearing Configurations*
- *Saving Configurations*
- *Resetting the Cisco Wireless LAN Controller*
- *Logging Out of the CLI*

Cisco Wireless LAN Controller Failover Protection

Each Cisco Wireless LAN Controller has a defined number of communication ports for Cisco 1000 Series lightweight access points. (The number of ports supported is listed in the *Cisco 2000 Series Wireless LAN Controller Model Numbers*, *Cisco 4100 Series Wireless LAN Controller Model Numbers*, and *Cisco 4400 Series Wireless LAN Controller Model Numbers* sections.) This means that when multiple Cisco Wireless LAN Controllers with unused Cisco 1000 Series lightweight access point ports are deployed on the same network, if one Cisco Wireless LAN Controller fails, the dropped Cisco 1000 Series lightweight access points automatically poll for unused Cisco Wireless LAN Controller ports and associate with them.

> **Note:** During installation, Cisco recommends that you connect all Cisco 1000 Series lightweight access points to a dedicated Cisco Wireless LAN Controller, and configure each Cisco 1000 Series lightweight access point for final operation. This step configures each Cisco 1000 Series lightweight access point for a *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller*, and allows it to store the configured *Cisco WLAN Solution Mobility Group* information.
>
> During failover recovery, the configured Cisco 1000 Series lightweight access points obtain an IP address from the local DHCP server (only in Layer 3 Operation), attempt to contact their Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers, and then attempt to contact the IP addresses of the other Cisco Wireless LAN Controllers in the Mobility group. This prevents the Cisco 1000 Series lightweight access points from spending time sending out blind polling messages, resulting in a faster recovery period.

In *Multiple-Cisco Wireless LAN Controller Deployments*, this means that if one Cisco Wireless LAN Controller fails, its dropped Cisco 1000 Series lightweight access points reboot and do the following under direction of the *Radio Resource Management (RRM)*:

- Obtain an IP address from a local DHCP server (one on the local subnet).
- If the Cisco 1000 Series lightweight access point has a *Primary, Secondary, and Tertiary Cisco Wireless LAN Controller* assigned, it attempts to associate with that Cisco Wireless LAN Controller.
- If the Cisco 1000 Series lightweight access point has no Primary, Secondary, or Tertiary Cisco Wireless LAN Controllers assigned or if its Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers are unavailable, it attempts to associate with a *Master Cisco Wireless LAN Controller* on the same subnet.

- If the Cisco 1000 Series lightweight access point finds no Master Cisco Wireless LAN Controller on the same subnet, it attempts to contact stored Mobility Group members by IP address.
- Should none of the Mobility Group members be available, and if the Cisco 1000 Series lightweight access point has no Primary, Secondary, and Tertiary Cisco Wireless LAN Controllers assigned and there is no Master Cisco Wireless LAN Controller active, it attempts to associate with the least-loaded Cisco Wireless LAN Controller on the same subnet to respond to its discovery messages with unused ports.

This means that when sufficient Cisco Wireless LAN Controllers are deployed, should one Cisco Wireless LAN Controller fail, active Cisco 1000 Series lightweight access point client sessions are momentarily dropped while the dropped Cisco 1000 Series lightweight access point associates with an unused port on another Cisco Wireless LAN Controller, allowing the client device to immediately reassociate and reauthenticate.

Cisco Wireless LAN Controller Automatic Time Setting

Each Cisco Wireless LAN Controller can have its time manually set or can be configured to obtain the current time from one or more Network Time Protocol (NTP) servers. Each NTP server IP address is added to the Cisco Wireless LAN Controller database. Each Cisco Wireless LAN Controller searches for an NTP server and obtains the current time upon reboot and at each user-defined polling interval (daily to weekly).

Cisco Wireless LAN Controller Time Zones

Each Cisco Wireless LAN Controller can have its time zone manually set or can be configured to obtain the current time from one or more Network Time Protocol (NTP) servers. Each NTP server IP address is added to the Cisco Wireless LAN Controller database. Each Cisco Wireless LAN Controller can search for an NTP server and obtain the current time zone upon reboot and at each user-defined (daily to weekly) polling interval.

Network Connections to Cisco Wireless LAN Controllers

Regardless of operating mode, all Cisco Wireless LAN Controllers use the network as an 802.11 Distribution System. Regardless of the Ethernet port type or speed, each Cisco Wireless LAN Controller monitors and communicates with its related Cisco Wireless LAN Controllers across the network. The following sections give details of these network connections:

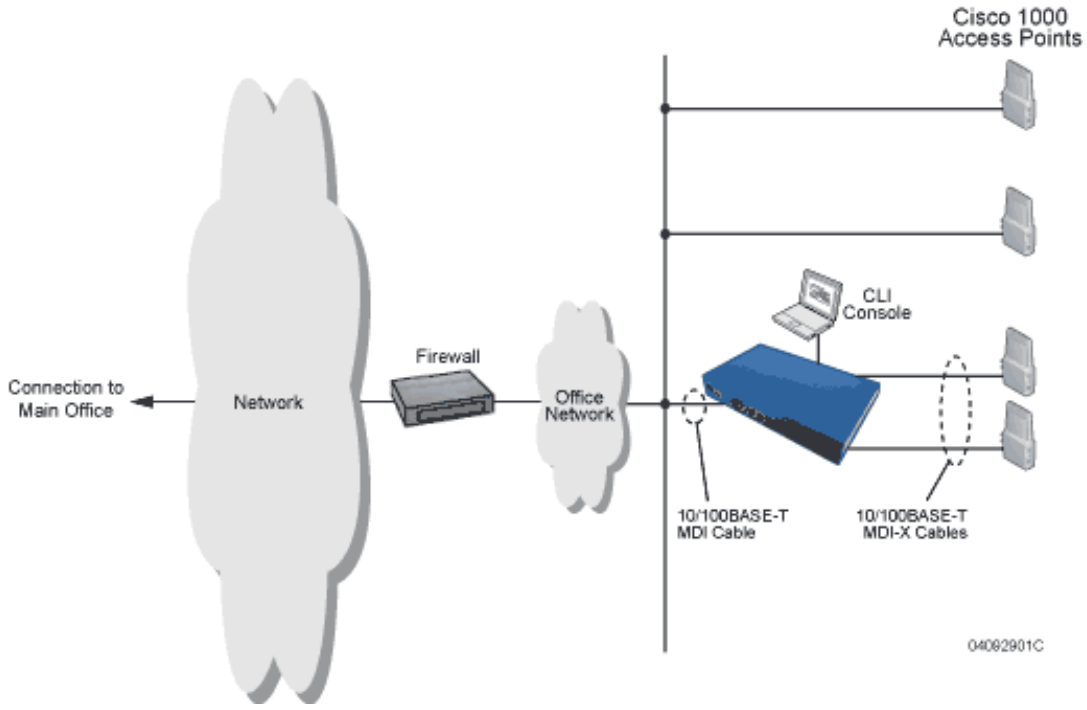
- *Cisco 2000 Series Wireless LAN Controllers*
- *Cisco 4100 Series Wireless LAN Controllers*
- *Cisco 4400 Series Wireless LAN Controllers*

Cisco 2000 Series Wireless LAN Controllers

Cisco 2000 Series Wireless LAN Controllers can communicate with the network through any one of its physical ports, as the logical *Management Interface* can be assigned to the one of the physical ports. The physical port description follows:

- Up to four 10/100BASE-T cables can plug into the four back-panel connectors on the Cisco 2000 Series Wireless LAN Controller chassis.

Figure - Physical Network Connections to the Cisco 2000 Series Wireless LAN Controller



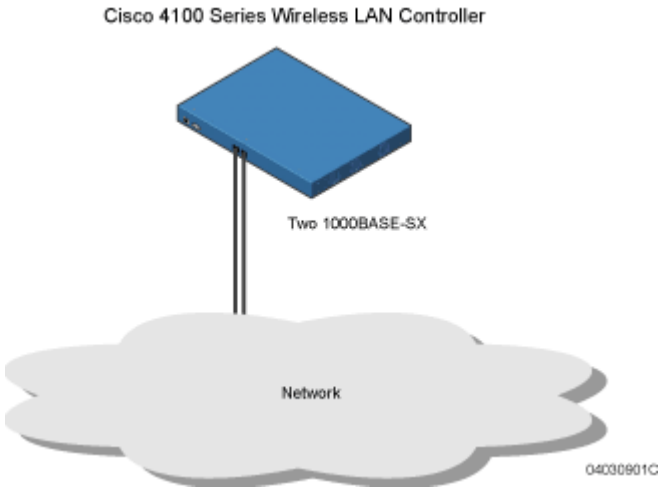
Cisco 4100 Series Wireless LAN Controllers

Cisco 4100 Series Wireless LAN Controllers can communicate with the network through one or two physical ports, and the logical *Management Interface* can be assigned to the one or two physical ports. The physical port description follows:

- Two GigE 1000BASE-SX fiber-optic cables can plug into the LC connectors on the front of the Cisco 4100 Series Wireless LAN Controller, and they must be connected to the same subnet. Note that the two GigE ports are redundant--the first port that becomes active is the master, and the second port becomes the backup port. If the first connection fails, the standby connection becomes the master, and the failed connection becomes the backup port.

Note that the 1000BASE-SX circuits provides 100/1000 Mbps wired connections to the network through 850nM (SX) fiber-optic links using LC physical connectors.

Figure - Physical Network Connections to the Cisco 4100 Series Wireless LAN Controller

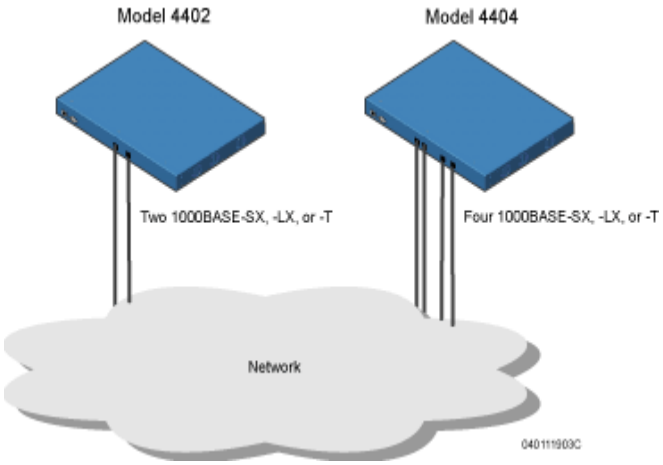


Cisco 4400 Series Wireless LAN Controllers

Cisco 4400 Series Wireless LAN Controllers can communicate with the network through one or two pairs of physical ports, and the logical *Management Interface* can be assigned to the physical ports. The physical port descriptions follows:

- For the 4402 Cisco Wireless LAN Controller, up to two of the following connections are supported in any combination:
  - 1000BASE-T (GigE, front panel, RJ-45 physical port, UTP cable).
  - 1000BASE-SX (GigE, front panel, LC physical port, multi-mode 850nM (SX) fiber-optic links using LC physical connectors).
  - 1000BASE-LX (GigE, front panel, LC physical port, multi-mode 1300nM (LX/LH) fiber-optic links using LC physical connectors).
- For the 4404 Cisco Wireless LAN Controller, up to four of the following connections are supported in any combination:
  - 1000BASE-T (GigE, front panel, RJ-45 physical port, UTP cable).
  - 1000BASE-SX (GigE, front panel, LC physical port, multi-mode 850nM (SX) fiber-optic links using LC physical connectors).
  - 1000BASE-LX (GigE, front panel, LX physical port, multi-mode 1300nM (LX/LH) fiber-optic links using LC physical connectors).

Figure - Physical Network Connections to 4402 and 4404 Cisco Wireless LAN Controllers



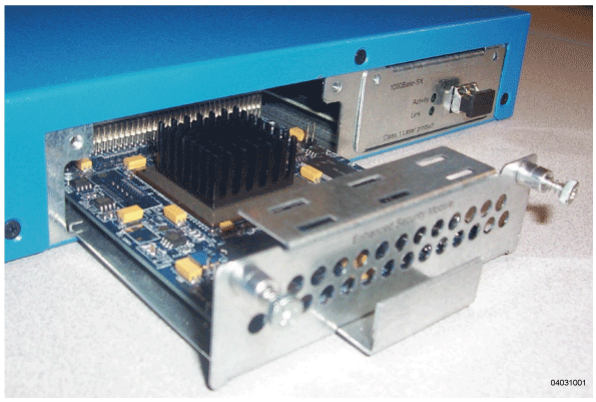
Cisco 4100 Series Wireless LAN Controller VPN/Enhanced Security Module

All Cisco 4100 Series Wireless LAN Controllers can be equipped with an optional VPN/Enhanced Security Module (AIR-VPN-4100), which slides into the rear panel of the Cisco 4100 Series Wireless LAN Controller. The VPN/Enhanced Security Module adds significant hardware encryption acceleration to the Cisco 4100 Series Wireless LAN Controller, which enables the following through the *Management Interface*:

- Provide a built-in VPN server for mission-critical traffic.
- Sustain up to 1 Gbps throughput with Layer 2 and Layer 3 encryption enabled.
- Support high-speed, processor-intensive encryption, such as L2TP, IPSec and 3DES.

The following figure shows the VPN/Enhanced Security Module sliding into the rear of a Cisco 4100 Series Wireless LAN Controller.

Figure - Cisco 4100 Series Wireless LAN Controller VPN/Enhanced Security Module Location



About Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Points

The Cisco 1000 Series lightweight access point is a part of the innovative Cisco Wireless LAN Solution (Cisco WLAN Solution). When associated with *Cisco Wireless LAN Controllers* as described below, the Cisco 1000 Series lightweight access point provides advanced 802.11a and/or 802.11b/g Access Point functions in a single aesthetically pleasing plenum-rated enclosure. The following figure shows the two types of Cisco 1000 Series IEEE 802.11a/b/g lightweight access point: without and with connectors for external antennas.

Note that Cisco WLAN Solution also offers 802.11a/b/g *Cisco 1030 Remote Edge Lightweight Access Points*, which are Cisco 1000 Series lightweight access points designed for remote deployment, Radio Resource Management (RRM) control via a WAN link, and which include connectors for external antennas.

Figure - Cisco 1000 Series Lightweight Access Points

A. External-Antenna Model B. Internal-Antenna Model

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Note that the Cisco 1000 Series lightweight access point is manufactured in a neutral color so it blends into most environments (but can be painted), contains pairs of high-gain internal antennas for unidirectional (180-degree) or omnidirectional (360-degree) coverage (*Cisco 1000 Series Lightweight Access Point External and Internal Antennas*), and is plenum-rated for installations in hanging ceiling spaces.

In the Cisco WLAN Solution, most of the processing responsibility is removed from traditional SOHO (small office, home office) access points and resides in the Cisco Wireless LAN Controller.

Refer to the following for more information on Cisco 1000 Series lightweight access points:

- *Cisco 1030 Remote Edge Lightweight Access Points*
- *Cisco 1000 Series Lightweight Access Point Part Numbers*
- *Cisco 1000 Series Lightweight Access Point External and Internal Antennas*

- *Cisco 1000 Series Lightweight Access Point LEDs*
- *Cisco 1000 Series Lightweight Access Point Connectors*
- *Cisco 1000 Series Lightweight Access Point Power Requirements*
- *Cisco 1000 Series Lightweight Access Point External Power Supply*
- *Cisco 1000 Series Lightweight Access Point Mounting Options*
- *Cisco 1000 Series Lightweight Access Point Physical Security*
- *Cisco 1000 Series Lightweight Access Point Monitor Mode*
- Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Deployment Guide
- Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide
- External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide

About Cisco 1030 Remote Edge Lightweight Access Points

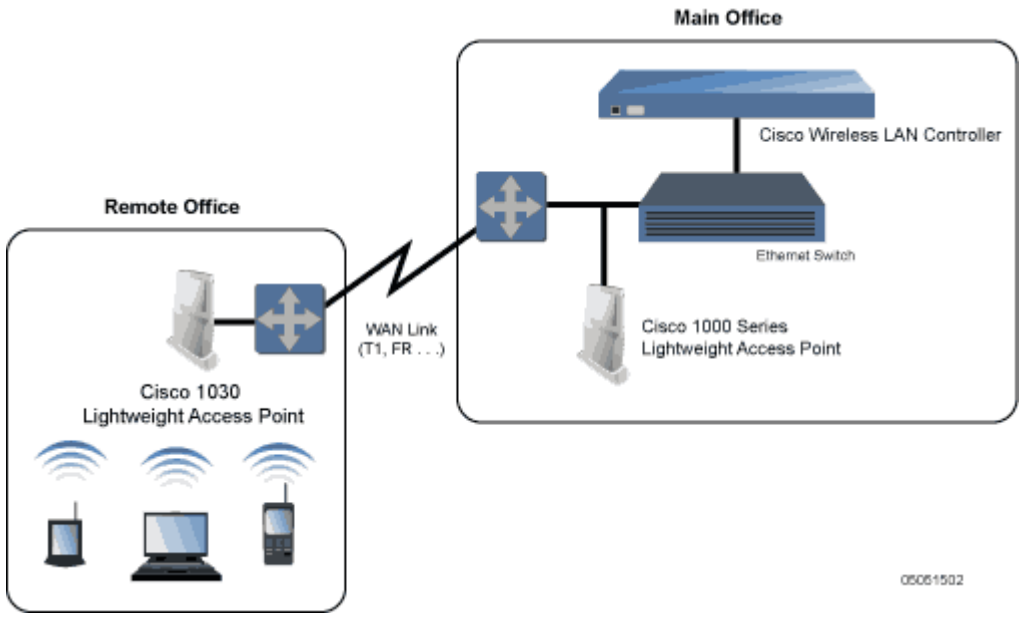
The only exception to the general rule of *Cisco 1000 Series Lightweight Access Points* being continuously controlled by Cisco Wireless LAN Controllers is the Cisco 1030 IEEE 802.11a/b/g remote edge lightweight access point (Cisco 1030 remote edge lightweight access point). The Cisco 1030 remote edge lightweight access point is intended to be located at a remote site, initially configured by a Cisco Wireless LAN Controller, and normally controlled by a Cisco Wireless LAN Controller.

However, because the Cisco 1030 remote edge lightweight access point bridges the client data (compared with other Cisco 1000 Series lightweight access points, which pass all client data through their respective Cisco Wireless LAN Controller), if the WAN link breaks between the Cisco 1030 remote edge lightweight access point and its Cisco Wireless LAN Controller, the Cisco 1030 remote edge lightweight access point continues transmitting WLAN 1 client data through other Cisco 1030 remote edge lightweight access points on its local subnet. However, it cannot take advantage of features accessed from the Cisco Wireless LAN Controller, such as establishing new VLANs, until communication is reestablished.

The Cisco 1030 remote edge lightweight access point includes the traditional SOHO (small office, home office) AP processing power, and thus can continue operating if the WAN link to its associated Cisco Wireless LAN Controller fails. Because it is configured by its associated Cisco Wireless LAN Controller, it has the same WLAN configuration as the rest of the Cisco WLAN Solution (refer to *Cisco WLAN Solution WLANs*). As long as it remains connected to its Cisco Wireless LAN Controller, it varies its transmit power and channel selection under control of the *Radio Resource Management (RRM)*, and performs the same rogue access point location as any other Cisco 1000 Series lightweight access point.

Note that the Cisco 1030 remote edge lightweight access point can support multiple WLANs while it is connected to its Cisco Wireless LAN Controller. However, when it loses connection to its Cisco Wireless LAN Controller, it supports only one WLAN on its local subnet.

The following figure shows a typical Cisco 1030 remote edge lightweight access point configuration:



Note that the Cisco 1030 remote edge lightweight access point must have a DHCP server available on its local subnet, so it can obtain an IP address upon reboot. Also note that the Cisco 1030 remote edge lightweight access points at each remote location must be on the same subnet to allow client roaming.

Refer to the following for more information on Cisco 1000 Series lightweight access points:

- *Cisco 1000 Series Lightweight Access Points*
- *Cisco 1000 Series Lightweight Access Point Part Numbers*
- *Cisco 1000 Series Lightweight Access Point External and Internal Antennas*
- *Cisco 1000 Series Lightweight Access Point LEDs*
- *Cisco 1000 Series Lightweight Access Point Connectors*
- *Cisco 1000 Series Lightweight Access Point Power Requirements*
- *Cisco 1000 Series Lightweight Access Point External Power Supply*
- *Cisco 1000 Series Lightweight Access Point Mounting Options*
- *Cisco 1000 Series Lightweight Access Point Physical Security*
- *Cisco 1000 Series Lightweight Access Point Monitor Mode*
- Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Deployment Guide
- Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide
- External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide

About Cisco 1000 Series Lightweight Access Point Part Numbers

The Cisco 1000 Series lightweight access point includes one 802.11a and one 802.11b/g radio. The Cisco 1000 Series lightweight access point is available in the following configurations:

- AIR-AP1010-A-K9, AIR-AP1010-C-K9, AIR-AP1010-E-K9, AIR-AP1010-J-K9, AIR-AP1010-N-K9, and AIR-AP1010-S-K9 - AP1010 Cisco 1000 Series lightweight access point four high-gain internal antennas, one 5 GHz external antenna adapter and two 2.4 GHz external antenna adapters.
- AIR-AP1020-A-K9, AIR-AP1020-C-K9, AIR-AP1020-E-K9, AIR-AP1020-J-K9, AIR-AP1020-N-K9, and AIR-AP1020-S-K9 - AP1020 Cisco 1000 Series lightweight access point with four high-gain internal antennas, and no external antenna adapters.
- AIR-AP1030-A-K9, AIR-AP1030-C-K9, AIR-AP1030-E-K9, AIR-AP1030-J-K9, AIR-AP1030-N-K9, and AIR-AP1030-S-K9 - AP1030 Cisco 1000 Series lightweight access point (Cisco 1030 remote edge lightweight access point) with one 5 GHz external antenna adapter and two 2.4 GHz external antenna adapters.

> **Note:** Refer to *Cisco WLAN Solution Supported Country Codes* for the most recent information on supported Regulatory Domains.

The Cisco 1000 Series lightweight access point is shipped with a color-coordinated ceiling mount base and hanging-ceiling rail clips. You can also order projection- and flush-mount sheet metal wall mounting bracket kits. The base, clips, and optional brackets allow quick mounting to ceiling or wall.

The Cisco 1000 Series lightweight access point can be powered by *Power Over Ethernet* or by an *Cisco 1000 Series Lightweight Access Point External Power Supply*. The external power supply model is:

- AIR-PWR-1000 - Optional External 110-220 VAC-to-48 VDC Power Supply for any Cisco 1000 Series lightweight access point.

The Single Inline PoE injector model is:

- AIR-PWRINJ-1000AF - Optional Single 802.3af Inline Power over Ethernet Injector for any Cisco 1000 Series lightweight access point, powered by 90-250 VAC.

The projection and flush sheet metal wall mount bracket model is:

- AIR-ACC-WBRKT1000 - Optional sheet metal wall-mount bracket kit for any Cisco 1000 Series lightweight access point. Includes one projection-mount and one flush-mount bracket per kit.

About Cisco 1000 Series Lightweight Access Point External and Internal Antennas

> **Note:** Cisco 1000 Series lightweight access points must use the factory-supplied internal or external antennas to avoid violating FCC requirements and voiding the user's authority to operate the equipment. Refer to *FCC Statements for Cisco 1000 Series Lightweight Access Points* for detailed information.

The Cisco 1000 Series lightweight access point enclosure contains one 802.11a or one 802.11b/g radio and four (two 802.11a and two 802.11b/g) high-gain antennas, which can be independently enabled or disabled to produce a 180-degree sectorized or 360-degree omnidirectional coverage area.

Note that the wireless LAN operator can disable either one of each pair of the Cisco 1000 Series light-weight access point internal antennas to produce a 180-degree sectorized coverage area. This feature can be useful, for instance, for outside-wall mounting locations where coverage is only desired inside the building, and in a back-to-back arrangement that can allow twice as many clients in a given area.

The following sections contain more information about Cisco 1000 Series lightweight access point internal and external antennas:

- *External Antenna Connectors*
- *Antenna Sectorization*
- *802.11a Internal Antenna Patterns*
- *802.11b/g Internal Antenna Patterns*

External Antenna Connectors

The AP1020 and AP1030 Cisco 1000 Series lightweight access points have male reverse-polarity TNC jacks for installations requiring factory-supplied external directional or high-gain antennas. The external antenna option can create more flexibility in Cisco 1000 Series lightweight access point antenna placement.

> **Note:** The AP1010 Cisco 1000 Series lightweight access points are designed to be used exclusively with the internal high-gain antennas, and have no jacks for external antennas.

Note that the 802.11b/g 2.4 GHz Left external antenna connector is associated with the internal Side A antenna, and that the 2.4 GHz Right external antenna connector is associated with the internal Side B antenna. When you have 802.11b/g diversity enabled, the Left external or Side A internal antennas are diverse from the Right external or Side B internal antennas.

Also note that the 802.11a 5 GHz Left external antenna connector is separate from the internal antennas, and adds diversity to the 802.11a transmit and receive path. Note that no external 802.11a antennas are certified in FCC-regulated areas, but external 802.11a antennas may be certified for use in other countries.

Antenna Sectorization

Note that the Cisco WLAN Solution supports Antenna Sectorization, which can be used to increase the number of clients and/or client throughput in a given air space. Installers can mount two Cisco 1000 Series lightweight access points back-to-back, and the Network operator can disable the second antenna in both Cisco 1000 Series lightweight access points to create a 360-degree coverage area with two sectors.

Installers can also mount Cisco 1000 Series lightweight access points on the periphery of a building and disable the Side B internal antennas. This configuration can be used to supply service to the building interior without extending coverage to the parking lot, at the cost of eliminating the internal antenna diversity function.

802.11a Internal Antenna Patterns

The Cisco 1000 Series lightweight access points contain one 802.11a radio, which drives two fully enclosed high-gain antennas that provide a large 360-degree coverage area. The two internal antennas are used at the same time to provide a 360-degree omnidirectional coverage area, or either antenna can be disabled to provide a 180-degree sectorized coverage area.

When equipped with an optional factory-supplied external antenna, the 802.11a Cisco Radio supports receive and transmit diversity between the internal antennas and the external antenna. The diversity function provided by Cisco Radios can result in lower multipath fading, fewer packet retransmissions, and higher client throughput.

Figure - Cisco 1000 Series Lightweight Access Point 802.11a OMNI (Dual Internal) Azimuth Antenna Gain Pattern

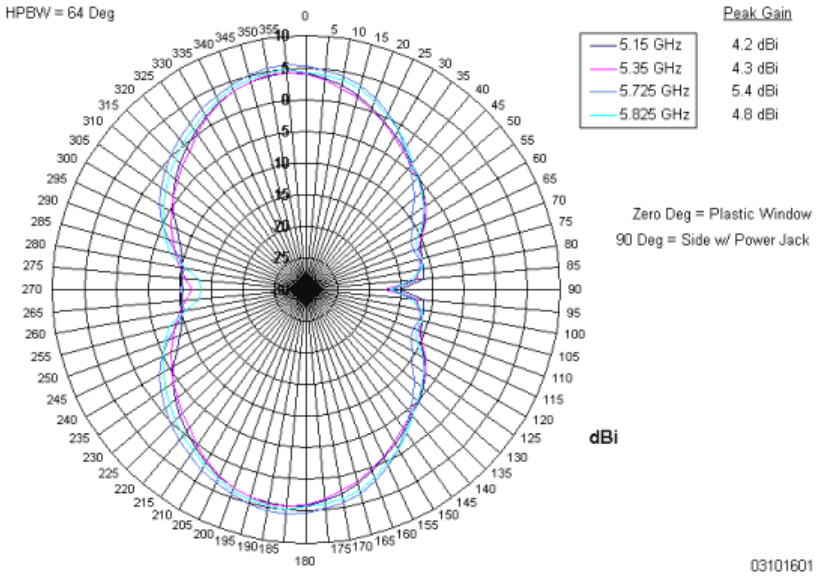


Figure - Cisco 1000 Series Lightweight Access Point 802.11a OMNI (Dual Internal) Elevation Antenna Gain Pattern

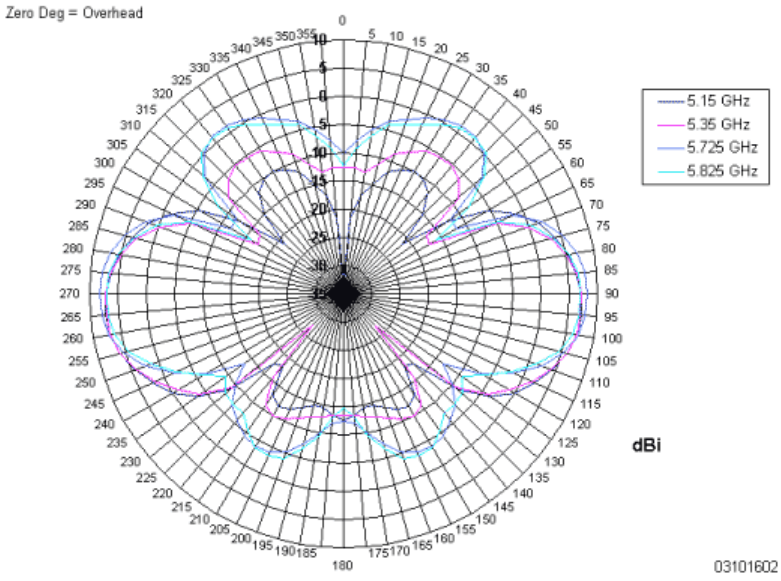
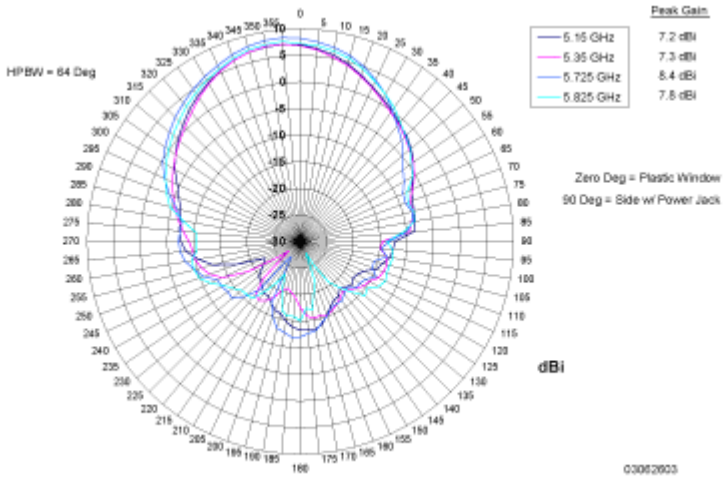
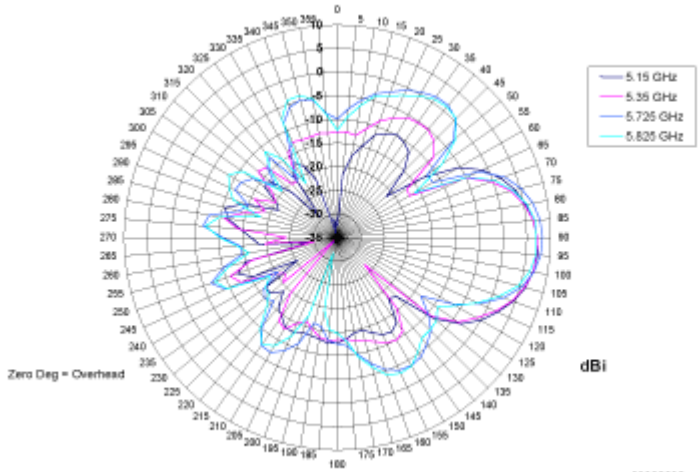


Figure - Cisco 1000 Series Lightweight Access Point 802.11a Sectorized (Single Internal) Azimuth Antenna Gain Pattern



Azimuth Pattern; 5 GHz Antenna; Sector Mode

Figure - Cisco 1000 Series Lightweight Access Point 802.11a Sectorized (Single Internal) Elevation Antenna Gain Pattern



Elevation Pattern; 5 GHz Antenna; Sector Mode

802.11b/g Internal Antenna Patterns

The Cisco 1000 Series lightweight access points contain one 802.11b/g radio which drives two fully enclosed high-gain antennas which can provide a large 360-degree coverage area. The two internal antennas can be used at the same time to provide a 360-degree omnidirectional coverage area, or either antenna can be disabled to provide a 180-degrees sectorized coverage area.

The 802.11b/g Cisco Radios support receive and transmit diversity between the internal antennas and/or optional factory-supplied external antennas.

Figure - Cisco 1000 Series Lightweight Access Point 802.11b/g OMNI (Dual Internal) Azimuth Antenna Gain Pattern

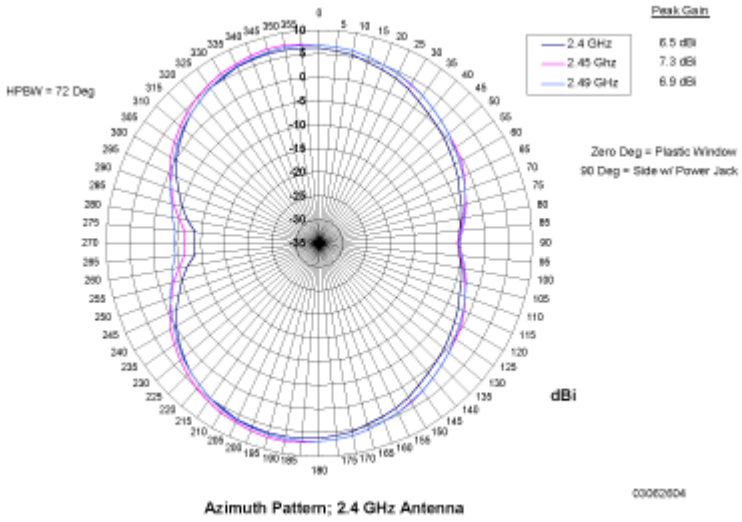


Figure - Cisco 1000 Series Lightweight Access Point 802.11b/g OMNI (Dual Internal) Elevation Antenna Gain Pattern

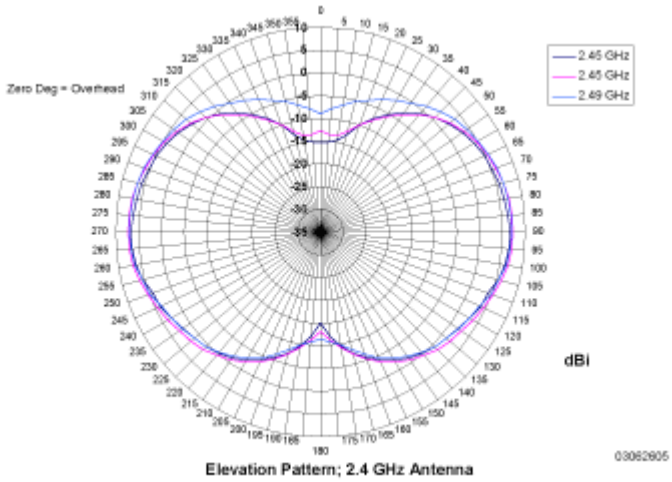


Figure - Cisco 1000 Series Lightweight Access Point 802.11b/g Sectorized (Single Internal) Azimuth Antenna Gain Pattern

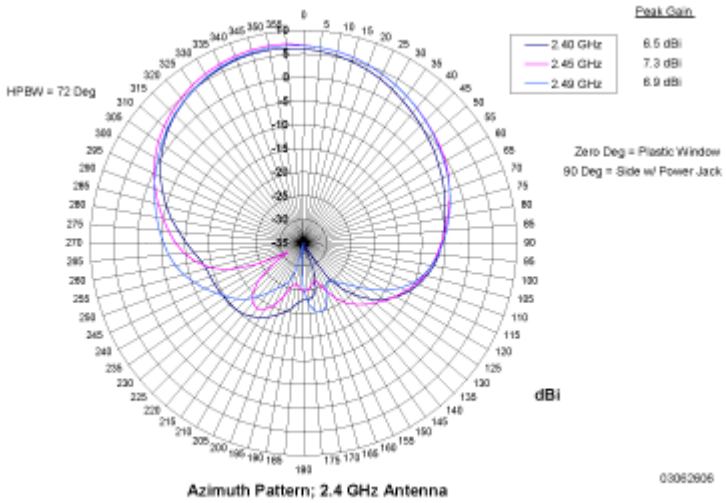
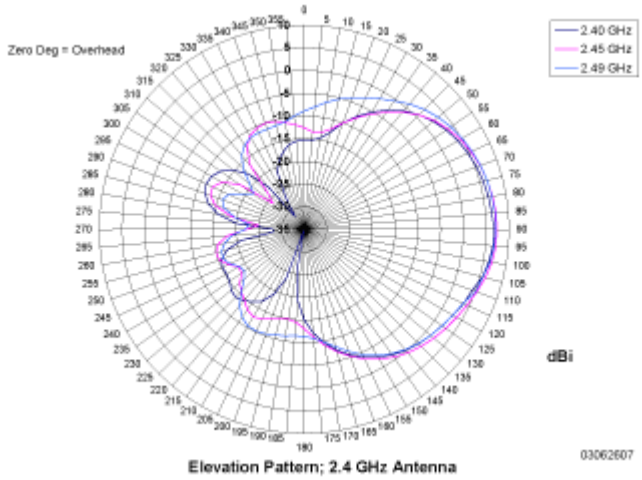


Figure - Cisco 1000 Series Lightweight Access Point 802.11b/g Sectorized (Single Internal) Elevation Antenna Gain Pattern



About Cisco 1000 Series Lightweight Access Point LEDs

Each Cisco 1000 Series lightweight access point is equipped with four LEDs across the top of the case. They can be viewed from nearly any angle. The LEDs indicate power and fault status, 2.4 GHz (802.11b/g) Cisco Radio activity, and 5 GHz (802.11a) Cisco Radio activity.

This LED display allows the wireless LAN manager to quickly monitor the Cisco 1000 Series lightweight access point status. For more detailed troubleshooting instructions, refer to the *Troubleshooting Tips* section.

About Cisco 1000 Series Lightweight Access Point Connectors

The AP1020 and AP1030 Cisco 1000 Series lightweight access points have the following external connectors:

- One RJ-45 Ethernet jack, used for connecting the Cisco 1000 Series lightweight access point to the network.
- One 48 VDC power input jack, used to plug in an optional factory-supplied external power adapter.
- Three male reverse-polarity TNC antenna jacks, used to plug optional external antennas into the Cisco 1000 Series lightweight access point: two for an 802.11b/g radio, and one for an 802.11a radio.

> **Note:** The AP1010 Cisco 1000 Series lightweight access points are designed to be used exclusively with the internal high-gain antennas, and have no jacks for external antennas.

Figure - Cisco 1000 Series Lightweight Access Point External Antenna Connectors

A. 2.4 GHz/802.11b Left External Antenna, Power, and Ethernet

B. 5 GHz/802.11a and 2.4 GHz/802.11b Right External Antennas

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The Cisco 1000 Series lightweight access point communicates with a Cisco Wireless LAN Controller using standard CAT-5 (Category 5) or higher 10/100 Mbps twisted pair cable with RJ-45 connectors. Plug the CAT-5 cable into the RJ-45 jack on the side of the Cisco 1000 Series lightweight access point.

Note that the Cisco 1000 Series lightweight access point can receive power over the CAT-5 cable from network equipment. Refer to *Power Over Ethernet* for more information about this option.

The Cisco 1000 Series lightweight access point can be powered from an optional factory-supplied external AC-to-48 VDC power adapter. If you are powering the Cisco 1000 Series lightweight access point using an external adapter, plug the adapter into the 48 VDC power jack on the side of the Cisco 1000 Series lightweight access point.

The Cisco 1000 Series lightweight access point includes two 802.11a and two 802.11b/g high-gain internal antennas, which provide omnidirectional coverage. However, some Cisco 1000 Series lightweight access points can also use optional factory-supplied external high-gain and/or directional antennas, as described in *Cisco 1000 Series Lightweight Access Point External and Internal Antennas*. When you are using external antennas, plug them into the male reverse-polarity TNC jacks on the side of the AP1020 and AP1030 Cisco 1000 Series lightweight access points as described in the External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide.

> **Note:** The Cisco 1000 Series lightweight access points must use the factory-supplied internal or external antennas to avoid violating FCC regulations and voiding the user's authority to operate the equipment, as described in *FCC Statements for Cisco 1000 Series Lightweight Access Points*.

About Cisco 1000 Series Lightweight Access Point Power Requirements

Each Cisco 1000 Series lightweight access point requires a 48 VDC nominal (between 38 and 57 VDC) power source capable of providing 7 Watts. The polarity of the DC source does not matter because the Cisco 1000 Series lightweight access point can use either a +48 VDC or a -48 VDC nominal source.

Cisco 1000 Series lightweight access points can receive power from the *Cisco 1000 Series Lightweight Access Point External Power Supply* (which draws power from a 110-220 VAC electrical outlet) plugged into the side of the Cisco 1000 Series lightweight access point case, or from *Power Over Ethernet*.

Figure - Typical Cisco 1000 Series Lightweight Access Point External Power Supply

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About Cisco 1000 Series Lightweight Access Point External Power Supply

The Cisco 1000 Series lightweight access point can receive power from an external 110-220 VAC-to-48 VDC power supply or from *Power Over Ethernet* equipment.

The external power supply (AIR-PWR-1000) plugs into a secure 110 through 220 VAC electrical outlet. The converter produces the required 48 VDC output (*Cisco 1000 Series Lightweight Access Point Power Requirements*) for the Cisco 1000 Series lightweight access point. The converter output feeds into the side of the Cisco 1000 Series lightweight access point through a 48 VDC jack (*Cisco 1000 Series Lightweight Access Point Connectors*).

Note that the AIR-PWR-1000 external power supply can be ordered with country-specific electrical outlet power cords. Contact Cisco when ordering to receive the correct power cord.

About Cisco 1000 Series Lightweight Access Point Mounting Options

Refer to the Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide or the External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide for the Cisco 1000 Series lightweight access point mounting options.

About Cisco 1000 Series Lightweight Access Point Physical Security

The side of the Cisco 1000 Series lightweight access point housing includes a slot for a Kensington MicroSaver Security Cable. You can use any MicroSaver Security Cable to ensure that your Cisco 1000 Series lightweight access point stays where you mounted it!

Refer to the *Kensington* website for more information about their security products, or to the Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide or External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide for installation instructions.

About Cisco 1000 Series Lightweight Access Point Monitor Mode

The Cisco 1000 Series lightweight access points and Cisco Wireless LAN Controllers can perform rogue access point detection and containment while providing regular service. The rogue access point detection is performed across all 801.11 channels, regardless of the Country Code selected. (Refer to *Cisco WLAN Solution Supported Country Codes* for more details).

However, if the administrator would prefer to dedicate specific Cisco 1000 Series lightweight access points to rogue access point detection and containment, the Monitor mode should be enabled for individual Cisco 1000 Series lightweight access points.

The Monitor function is set for all 802.11 Cisco Radios on a per-Cisco 1000 Series lightweight access point basis using any of the Cisco Wireless LAN Controller user interfaces described in *About the Cisco Wireless LAN Solution*.

About Rogue Access Points

Because they are inexpensive and readily available, employees are plugging unauthorized rogue access points into existing LANs and building ad hoc wireless networks without IT department knowledge or consent.

These rogue access points can be a serious breach of network security, because they can be plugged into a network port behind the corporate firewall. Because employees generally do not enable any security settings on the rogue access point, it is easy for unauthorized users to use the access point to intercept network traffic and hijack client sessions. Even more alarming, wireless users and war chalkers frequently publish unsecure access point locations, increasing the odds of having the enterprise security breached.

Rather than using a person with a scanner to manually detect rogue access point, the Cisco WLAN Solution automatically collects information on rogue access point detected by its managed *Cisco 1000 Series Lightweight Access Points*, by MAC and IP Address, and allows the system operator to locate, tag and monitor them as described in the *Detecting and Locating Rogue Access Points* section. The Operating System can also be used to discourage rogue access point clients by sending them deauthenticate and disassociate messages from one to four Cisco 1000 Series lightweight access points. Finally, the Operating System can be used to automatically discourage all clients attempting to authenticate with all rogue access point on the enterprise subnet. Because this real-time detection is automated, it saves labor costs used for detecting and monitoring rogue access point while vastly improving LAN security.

Note that the peer-to-peer, or ad-hoc, clients can also be considered rogue access point.

See also *Rogue Access Point Location, Tagging and Containment*.

Rogue Access Point Location, Tagging and Containment

This built-in detection, tagging, monitoring and containment capability allows system administrators to take required actions:

- Locate rogue access point as described in *Detecting and Locating Rogue Access Points*.
- Receive new rogue access point notifications, eliminating hallway scans.
- Monitor unknown rogue access point until they are eliminated or acknowledged.
- Determine the closest authorized *Cisco 1000 Series Lightweight Access Points*, making directed scans faster and more effective.
- Contain rogue access points by sending their clients deauthenticate and disassociate messages from one to four Cisco 1000 Series lightweight access points. This containment can be done for individual rogue access points by MAC address, or can be mandated for all rogue access points connected to the enterprise subnet.
- Tag rogue access point:
  - Acknowledge rogue access point when they are outside of the LAN and do not compromise the LAN or WLAN security.
  - Accept rogue access point when they do not compromise the LAN or WLAN security.
  - Tag rogue access point as unknown until they are eliminated or acknowledged.
  - Tag rogue access point as contained and discourage clients from associating with the rogue access point by having between one and four Cisco 1000 Series lightweight access points transmit deauthenticate and disassociate messages to all rogue access point clients. This function contains all active channels on the same rogue access point.

Rogue Detector mode detects whether or not a rogue access point is on a trusted network. It does not provide RF service of any kind, but rather receives periodic rogue access point reports from the Cisco

Wireless LAN Controller, and sniffs all ARP packets. If it finds a match between an ARP request and a MAC address it receives from the Cisco Wireless LAN Controller, it generates a rogue access point alert to the Cisco Wireless LAN Controller.

To facilitate automated rogue access point detection in a crowded RF space, Cisco 1000 Series light-weight access points can be configured to operate in *Cisco 1000 Series Lightweight Access Point Monitor Mode*, allowing monitoring without creating unnecessary interference.

About the Web User Interface

The Web User Interface is built into each Cisco Wireless LAN Controller. The Web User Interface allows up to five users to simultaneously browse into the built-in Cisco Wireless LAN Controller http or https (http + SSL) Web server, configure parameters, and monitor operational status for the Cisco Wireless LAN Controller and its associated Access Points.

> **Note:** Cisco strongly recommends that you enable the https: and disable the http: interfaces to ensure more robust security for your Cisco WLAN Solution.

Because the Web User Interface works with one Cisco Wireless LAN Controller at a time, the Web User Interface is especially useful when you wish to configure or monitor a single Cisco Wireless LAN Controller and its associated Cisco 1000 Series lightweight access points.

> **Note:** Some popup window filters can be configured to block the Web User Online Help windows. If your system cannot display the Online Help windows, disable or reconfigure your browser popup filter software.

Refer to *Using the Web User Interface* for more information on the Web User Interface.

About the Command Line Interface

The Cisco WLAN Solution command line interface (CLI) is built into each Cisco Wireless LAN Controller, and is one of the Operating System user interfaces described in *About the Cisco Wireless LAN Solution*. The CLI allows operators to use a VT-100 emulator to locally or remotely configure, monitor and control individual Cisco Wireless LAN Controllers, and to access extensive debugging capabilities.

Because the CLI works with one Cisco Wireless LAN Controller at a time, the command line interface is especially useful when you wish to configure or monitor a single Cisco Wireless LAN Controller.

The Cisco Wireless LAN Controller and its associated Cisco 1000 Series lightweight access points can be configured and monitored using the command line interface (CLI), which consists of a simple text-based, tree-structured interface that allows up to five users with Telnet-capable terminal emulators to simultaneously configure and monitor all aspects of the Cisco Wireless LAN Controller and associated Cisco 1000 Series lightweight access points.

Refer to *Using the Cisco WLAN Solution CLI* and the Cisco WLAN Solution CLI Reference for more information.

About the Cisco Wireless Control System

The Cisco Wireless Control System (Cisco WCS) is the Cisco Wireless LAN Solution network management tool that adds to the capabilities of the *Web User Interface* and the *Command Line Interface*, moving from individual Cisco Wireless LAN Controllers to a network of Cisco Wireless LAN Controllers. The Cisco Wireless Control System runs on Windows 2000, Windows 2003, and Red Hat Enterprise Linux ES servers.

The Cisco WCS includes the same configuration, performance monitoring, security, fault management, and accounting options used at the Cisco Wireless LAN Controller level, but adds a graphical view of multiple Cisco Wireless LAN Controller and managed Cisco 1000 Series lightweight access points.

The Cisco WCS is offered in two versions which support different feature levels:

- *Cisco WCS Base*, which includes wireless client data access, rogue access point containment functions, Cisco WLAN Solution monitoring and control, and which allows client and rogue access point location to the nearest Cisco 1000 Series lightweight access point.
- *Cisco WCS Location*, which is includes all the features in the *Cisco WCS Base*, but which allows high-accuracy rogue access point and client location to within 10 meters.

These features are listed in the following table:

Features	Cisco WCS Base	Cisco WCS Location
Location and Tracking:		
• Low-Resolution Client Location	Yes	-
• High-Resolution Client Location	-	Yes
• Low-Resolution Rogue Access Point Location	Yes	-
• High-Resolution Rogue Access Point Location	-	Yes
Client Data Services, Security and Monitoring:		
• Client Access via Cisco 1000 Series lightweight access points	Yes	Yes
• Multiple WLANs (Individual SSIDs and Policies)	Yes	Yes
Rogue Access Point Detecting and Containing using Cisco 1000 Series lightweight access points	Yes	Yes
802.11a/b/g Bands	Yes	Yes
Radio Resource Management (real-time assigning channels, and detecting and containing rogue access points)	Yes	Yes
Radio Resource Management (real-time detecting and avoiding interference, controlling transmit power, assigning channels, managing client mobility, distributing client load, and detecting coverage holes)	Yes	Yes
Automated Software and Configuration Updates	Yes	Yes
Wireless Intrusion Protection	Yes	Yes
Global and Individual AP Security Policies	Yes	Yes
Controls Cisco Wireless LAN Controllers	Yes	Yes

Features	Cisco WCS Base	Cisco WCS Location
Supported Workstations:		
• Windows 2000 or Windows 2003	Yes	Yes
• Red Hat Enterprise Linux ES Server	Yes	Yes

The Cisco Wireless Control System runs on Windows 2000 or 2003 and Red Hat Enterprise Linux ES servers. The Windows Cisco WCS can run as a normal Windows application, or can be installed as a service, which runs continuously and resumes running after a reboot. The Linux Cisco WCS always runs as a normal Linux application.

The *Cisco WCS User Interface* allows Cisco WCS operators to control all permitted Cisco WLAN Solution configuration, monitoring, and control functions through Internet Explorer 6.0 on a Windows workstation (or other) web browser window. The Cisco WCS operator permissions are defined by the Cisco WCS administrator in the Cisco WCS User Interface using the Cisco WCS User Interface Admin tab, which allows the Cisco WCS administrator to administer user accounts and schedule periodic maintenance tasks.

Cisco WCS simplifies Cisco Wireless LAN Controller configuring and monitoring while decreasing data entry errors with the *Cisco WCS Cisco Wireless LAN Controller Autodiscovery* algorithm. The Cisco WCS uses industry-standard SNMP protocol to communicate with Cisco Wireless LAN Controllers.

The Cisco WCS also includes the *Floor Plan Editor*, which allows you to vectorize bitmapped campus, floor plan, and outdoor area maps, add and change wall types, and import the resulting vector wall format maps into the Cisco WCS database. The vector files allow the Cisco WCS RF Prediction Tool to make much better RF predictions based on more accurate wall and window RF attenuation values.

About Cisco WCS Base

The Cisco WCS Base version supports wireless client data access, rogue access point detection and containment functions, Cisco WLAN Solution monitoring and control, and includes graphical views of the following:

- Auto-discovery of *Cisco 1000 Series Lightweight Access Points* as they associate with Cisco Wireless LAN Controllers.
- Auto-discovery, and containment or notification of *Rogue Access Points*.
- Map-based organization of Access Point coverage areas, helpful when the enterprise spans more than one geographical area. (Refer to *Using Cisco WCS* and *Checking the Cisco WLAN Solution Network Summary*.)
- User-supplied Campus, Building and Floor graphics, which show the following:
  - Locations and status of managed access points. (Refer to *Adding a Cisco Wireless LAN Controller to Cisco WCS*.)
  - Locations of rogue access points, based on signal strength received by the nearest managed Cisco 1000 Series lightweight access points. (Refer to *Detecting and Locating Rogue Access Points*.)
  - Coverage hole alarm information for Cisco 1000 Series lightweight access points is based on received signal strength from clients. This information appears in a tabular rather than map format. (Refer to *Finding Coverage Holes*.)
  - RF coverage maps.

- System-wide control:
  - Network, Cisco Wireless LAN Controller, and managed Cisco 1000 Series lightweight access point configuration is streamlined using customer-defined templates.
  - Network, Cisco Wireless LAN Controller, and managed Cisco 1000 Series lightweight access point status and alarm monitoring.
  - Automated and manual data client monitoring and control functions.
  - Automated monitoring: Rogue APs, coverage holes, security violations, Cisco Wireless LAN Controllers, and Cisco 1000 Series lightweight access points.
  - Full event logs available for data clients, rogue access points, coverage holes, security violations, Cisco Wireless LAN Controllers, and Cisco 1000 Series lightweight access points.
  - Automatic channel and power level assignment by *Radio Resource Management (RRM)*.
  - User-defined automatic Cisco Wireless LAN Controller status audits, missed trap polling, configuration backups, and policy cleanups.
- Real-time location of rogue access points to the nearest Cisco 1000 Series lightweight access point.
- Real-time and historical location of clients to the nearest Cisco 1000 Series lightweight access point.
- Runs on Windows 2000 or 2003 and Red Hat Enterprise Linux ES Server workstations.

About Cisco WCS Location

In addition to the graphical representations listed in *Cisco WCS Base*, Cisco WCS Location adds the following enhancements:

- On-demand location of rogue access points to within 10 meters.
- On-demand location of clients to within 10 meters.
- Runs on Windows 2000 or 2003 and Red Hat Enterprise Linux ES servers.
- Ability to use *Cisco 2700 Series Location Appliances* to collect and return historical location data viewable in the Cisco WCS Location user interface.

About the Cisco WCS User Interface

The Cisco WCS User Interface interface allows the network operator to create and configure Cisco WLAN Solution coverage area layouts, configure system operating parameters, monitor real-time Cisco WLAN Solution operation, and perform troubleshooting tasks using a standard HTTP or HTTPS web browser window. The Cisco WCS User Interface interface also allows a Cisco WCS administrator to create, modify and delete user accounts, change passwords, assign permissions, and schedule periodic maintenance tasks.

Cisco recommends Internet Explorer 6.0 or later on a Windows workstation web browser for full access to the Cisco WCS functionality.

> **Note:** The HTTPS (SSL over HTTP) interface is enabled by default, and the HTTP interface can be manually activated in the *Command Line Interface*, *Web User Interface* and *Cisco WCS User Interface*.

The Cisco WCS administrator creates new usernames passwords and assigns them to predefined permissions groups. This task is described in *Managing Cisco WCS and Database*.

Cisco WCS User Interface operators perform their tasks as described in *Using the Cisco Wireless Control System*.

About the Floor Plan Editor

Cisco WCS includes the Floor Plan Editor, which converts architectural, mechanical and technical drawings, graphics, maps and other types of line artwork from raster bitmaps to wall (vector) formats. Operators can use scanners to digitize paper drawings into supported file formats for import into Cisco WCS. The Floor Plan Editor automatically recognizes and represents the data in a wall format which can then be imported into your Cisco WCS (*Cisco Wireless Control System*) program.

Because of its ability to create smooth straight, angled, and semi-angled outlines, the Floor Plan Editor is used to convert floor plan maps, define the wall characteristics, and import the resulting vector wall format maps into the Cisco WCS database. The vector files allow the Cisco WCS RF Prediction Tool to make much better RF predictions based on Cisco 1000 Series lightweight access point signal strength, and accurate wall, window and cubicle RF attenuation.

Otherwise, you may want to save raster images in .BMP, .TIFF, .JPEG, or .PNG raster formats. Note that you can also edit existing vector map files.

The output wall files can be saved in vector (Cisco WLAN Solution wall format) for importing directly into the Cisco WCS database. The output wall files can also be saved in the following formats, but Cisco WCS does not recognize these file types: .DXF (AutoCAD), .AI (Adobe Illustrator), .EMF (enhanced metafile), .WMF (Windows metafile), and .TXT (ASCII XY).

Note that there are no restrictions on the input or output image size.

- **Note:** The quality of Floor Plan Editor recognition is higher for higher resolution data. Use 400 to 600 dots per inch (dpi) scans whenever possible.

- **Note:** Cisco WLAN Solution strongly recommends that you create images with the long axis horizontal (landscape format) to ensure the best viewing in Cisco WCS.

About Cisco WCS Cisco Wireless LAN Controller Autodiscovery

Manually adding Cisco Wireless LAN Controller data to a management database can be time consuming, and is susceptible to data entry errors. The *Cisco Wireless Control System* (Cisco WCS) includes a built-in Cisco Wireless LAN Controller configuration upload function that speeds up database creation while eliminating errors.

Cisco Wireless LAN Controller Autodiscovery is limited to the *Cisco WLAN Solution Mobility Group* subnets defined by the Cisco WLAN Solution operator.

Cisco Wireless LAN Controller Autodiscovery allows operators to search for a single Cisco Wireless LAN Controller by IP Address. The Autodiscovery function finds the Cisco Wireless LAN Controller on the network with the specified IP Address, and automatically enters the discovered Cisco Wireless LAN Controller information into the Cisco WCS database.

As *Cisco 1000 Series Lightweight Access Points* associate with a Cisco Wireless LAN Controller, the Cisco Wireless LAN Controller immediately transmits the Cisco 1000 Series lightweight access point information to Cisco WCS, which automatically adds the Cisco 1000 Series lightweight access point to the Cisco WCS database.

After the Cisco 1000 Series lightweight access point information is in the Cisco WCS database, operators can add the Cisco 1000 Series lightweight access point to the appropriate spot on a Cisco WCS User Interface map using *Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Open Area Maps*, so the topological map of the air space remains current.

About Cisco WCS Alarm Email Notification

The *Cisco Wireless Control System* (Cisco WCS) includes a built-in email notification function, which can notify network operators when Critical alarms occur.

Refer to the Cisco WCS Monitor All Alarms > Email Notification page to view the current alarm notification settings.

About Cisco WCS Location Calibration

The *Cisco Wireless Control System* (Cisco WCS) includes a calibration tool which allows Cisco WLAN Solution operators to accurately measure actual signal strength and attenuation in RF coverage areas, which creates an accurate calibration model in the Cisco WCS database. This calibration model allows more precise client and rogue access point location after calibration is completed. To save effort, the calibration model can also be reused for areas with an identical Cisco 1000 Series lightweight access point layout and identical wall layout.

The calibration tool is used much like a site survey tool, and allows a technician to take a Cisco WCS-equipped laptop to multiple locations on a floor or outdoor area and measure actual signal strength at selected locations on the floor or outdoor area map. The technician then uses the calibration tool in Cisco WCS to process the collected data points for the floor or outdoor area.

Refer to the Cisco WCS Monitor RF Calibration Models page to view the current calibration models.

About Cisco 2700 Series Location Appliances

The Cisco 2700 Series Location Appliance (location appliance) enhances the high-accuracy built-in *Cisco WCS Location* abilities by computing, collecting and storing historical location data, which can be displayed in Cisco WCS. In this role, the location appliance acts as a server to one or more Cisco WCS Servers, collecting, storing, and passing on data from its associated Cisco Wireless LAN Controllers.

After a quick command-line interface (CLI) configuration, the remaining location appliance configuration can be completed using the Cisco WCS interface.

After it is configured, each location appliance communicates directly with its associated Cisco Wireless LAN Controllers to collect operator-defined location data. The associated Cisco WCS Server operators can then communicate with each location appliance to transfer and display selected data.

The location appliance can be backed up to any Cisco WCS Server into an operator-defined FTP folder, and the location appliance can be restored from that Cisco WCS Server at any time and at defined intervals. Also, the location appliance database can be synchronized with the Cisco WCS Server database at any time.

Operators can use the location appliance features and download new application code to all associated location appliances from any Cisco WCS Server.

When Cisco WCS is enhanced with a location appliance, Cisco WCS can display historical location data for up to 1,500 Laptop Clients, Palmtop Clients, VoIP Telephone Clients, RFID (Radio Frequency IDentifier) Asset Tags, Rogue Access Points, and Rogue Access Point Clients for each location appliance in the Cisco WLAN Solution.

Operators can configure location appliances to collect data for Cisco WLAN Solution clients, rogue access points and clients, RFID Asset Tags, and statistics at separate operator-defined intervals.

The location appliance uses two redundant back-panel 10/100/1000BASE-T ports to connect to one or two network segments. It also features a back-panel power cord and front-panel ON/OFF switch. The location appliance includes a back-panel DB-9 console port for initial configuration using a CLI console.

Note that each location appliance can be installed in any NOC (Network Operations Center) or wiring closet from which it can communicate with its associated Cisco WCS Server(s) and Cisco Wireless LAN Controllers.

Refer to *Configuring and Operating Cisco 2700 Series Location Appliances* for more information.

SOLUTIONS

- *Cisco WLAN Solution Security*
- *Converting a Cisco WLAN Solution from Layer 2 to Layer 3 Mode*
- *Converting a Cisco WLAN Solution from Layer 3 to Layer 2 Mode*
- *Configuring a Firewall for Cisco WCS*
- *Configuring the System for SpectraLink NetLink Telephones*
- *Management over Wireless*
- *Configuring a WLAN for a DHCP Server*
- *Customizing the Web Auth Login Screen*
- *Configuring Identity Networking for Operating System*

Cisco WLAN Solution Security

Cisco WLAN Solution Security includes the following sections:

- *Overview*
- *Layer 1 Solutions*
- *Layer 2 Solutions*
- *Layer 3 Solutions*
- *Single Point of Configuration Policy Manager Solutions*
- *Rogue Access Point Solutions*
- *Integrated Security Solutions*
- *Simple, Cost-Effective Solutions*

Overview

The industry-leading Cisco WLAN Solution Security solution bundles potentially complicated Layer 1, Layer 2 and Layer 3 802.11 Access Point security components into a simple policy manager that customizes system-wide security policies on a per-WLAN basis (*Operating System Security*). Unlike SOHO (small office, home office) 802.11 products, the Cisco WLAN Solution Security solution provides simple, unified, and systematic security management tools.

One of the biggest hurdles to WLAN deployment in the enterprise is the WEP (Wired Equivalent Privacy) encryption, which has proven to be a weak standalone encryption method. A newer problem is the availability of low-cost access points, which can be connected to the enterprise network and used to mount 'man-in-the-middle' and denial-of-service attacks. Also, the complexity of add-on security solutions has prevented many IT managers from embracing the new 802.11 benefits. Finally, the 802.11 security configuration and management cost has been daunting for resource-bound IT departments.

Layer 1 Solutions

The Cisco WLAN Solution Operating System Security solution ensures that all clients gain access within an operator-set number of attempts. Should a client fail to gain access within that limit, it is automatically excluded (blocked from access) until the operator-set timer expires. The Operating System can also disable SSID broadcasts on a per-WLAN basis.

Layer 2 Solutions

If a higher level of security and encryption is required, the network administrator can also implement industry-standard security solutions, such as: 802.1X dynamic keys with EAP (extensible authentication protocol), or WPA (Wi-Fi protected access) dynamic keys. The Cisco WLAN Solution WPA implementation includes AES (advanced encryption standard), TKIP + Michael (temporal key integrity protocol + message integrity code checksum) dynamic keys, or WEP (Wired Equivalent Privacy) static keys. Disabling is also used to automatically block Layer 2 access after an operator-set number of failed authentication attempts.

Regardless of the wireless security solution selected, all Layer 2 wired communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are secured by passing data through LWAPP tunnels.

Layer 3 Solutions

The WEP problem can be further solved using industry-standard Layer 3 security solutions, such as VPNs (virtual private networks), L2TP (Layer Two Tunneling Protocol), and IPSec (IP security) protocols. The Cisco WLAN Solution L2TP implementation includes IPsec, and the IPSec implementation includes IKE (internet key exchange), DH (Diffie-Hellman) groups, and three optional levels of encryption: DES (ANSI X.3.92 data encryption standard), 3DES (ANSI X9.52-1998 data encryption standard), or AES/CBC (advanced encryption standard/cipher block chaining). Disabling is also used to automatically block Layer 3 access after an operator-set number of failed authentication attempts.

The Cisco WLAN Solution IPSec implementation also includes industry-standard authentication using: MD5 (message digest algorithm), or SHA-1 (secure hash algorithm-1).

The Cisco WLAN Solution supports local and RADIUS MAC (media access control) filtering. This filtering is best suited to smaller client groups with a known list of 802.11 access card MAC addresses.

Finally, the Cisco WLAN Solution supports local and RADIUS user/password authentication. This authentication is best suited to small to medium client groups.

Single Point of Configuration Policy Manager Solutions

When the Cisco WLAN Solution is equipped with Cisco WCS, you can configure system-wide security policies on a per-WLAN basis. SOHO Access Points force you to individually configure security policies on each access point, or use a third-party appliance to configure security policies across multiple access points.

Because the Cisco WLAN Solution security policies can be applied across the whole system from the Cisco Wireless Control System, errors can be eliminated and the overall effort is greatly reduced.

Rogue Access Point Solutions

Rogue Access Point Challenges

Rogue Access Points can disrupt WLAN operations by hijacking legitimate clients and using plaintext or other denial-of-service or man-in-the-middle attacks. That is, a hacker can use a rogue access point to capture sensitive information, such as passwords and username. The hacker can then transmit a series of clear-to-send (CTS) frames, which mimics an access point informing a particular NIC to transmit and instructing all others to wait, which results in legitimate clients being unable to access the WLAN resources. WLAN service providers thus have a strong interest in banning rogue access points from the air space.

The Operating System Security solution uses the *Radio Resource Management (RRM)* function to continuously monitor all nearby Cisco 1000 Series lightweight access points, automatically discover rogue access points and locate them as described in *Detecting and Locating Rogue Access Points*.

Tagging and Containing Rogue Access Points

When the Cisco WLAN Solution is monitored using *Cisco Wireless Control System*, Cisco WCS generates the flags as rogue access point traps, and displays the known rogue access points by MAC address. The operator can then display a map showing the location of the Cisco 1000 Series lightweight access points closest to each rogue access point, allowing Known or Acknowledged rogue access points (no further action), marking them as Alert rogue access points (watch for and notify when active), or marking them as Contained rogue access points (have between one and four Cisco 1000 Series lightweight access points discourage rogue access point clients by sending the clients deauthenticate and disassociate messages whenever they associate with the rogue access point).

When the Cisco WLAN Solution is monitored using an *Web User Interface* or an *Command Line Interface*, the interface displays the known rogue access points by MAC address. The operator then has the option of marking them as Known or Acknowledged rogue access points (no further action),

marking them as Alert rogue access points (watch for and notify when active), or marking them as Contained rogue access points (have between one and four Cisco 1000 Series lightweight access points discourage rogue access point clients by sending the clients deauthenticate and disassociate messages whenever they associate with the rogue access point).

Integrated Security Solutions

- Cisco WLAN Solution Operating System Security is built around a robust 802.1X AAA (authorization, authentication and accounting) engine, which allows operators to rapidly configure and enforce a variety of security policies across the Cisco WLAN Solution.
- The *Cisco Wireless LAN Controllers* and *Cisco 1000 Series Lightweight Access Points* are equipped with system-wide authentication and authorization protocols across all ports and interfaces, maximizing system security.
- Operating System Security policies are assigned to individual WLANs, and *Cisco 1000 Series Lightweight Access Points* simultaneously broadcast all (up to 16) configured WLANs. This can eliminate the need for additional access points, which can increase interference and degrade system throughput.
- The *Cisco Wireless LAN Controllers* securely terminates IPSec VPN clients, which can reduce the load on centralized VPN concentrators.
- Operating System Security uses the *Radio Resource Management (RRM)* function to continually monitor the air space for interference and security breaches, and notify the operator when they are detected.
- Operating System Security works with industry-standard aaa (authorization, authentication and accounting) servers, making system integration simple and easy.
- The Operating System Security solution offers comprehensive Layer 2 and Layer 3 encryption algorithms which typically require a large amount of processing power. Rather than assigning the encryption tasks to yet another server, the Cisco Wireless LAN Controller can be equipped with a VPN/Enhanced Security Module that provides extra hardware required for the most demanding security configurations.

Simple, Cost-Effective Solutions

Because the Cisco WLAN Solution Radio Resource Management (RRM) function is enabled from the factory, the IT department does not need to create a detailed rollout plan to continually monitor access points, or to individually update access points, resulting in very low input required from the IT department or Wireless LAN manager. This means less money spent deploying, configuring, updating, and monitoring the Cisco WLAN Solution.

Converting a Cisco WLAN Solution from Layer 2 to Layer 3 Mode

When you wish to convert a Cisco WLAN Solution from Layer 2 to Layer 3 Mode, use one of the following procedures:

- *Using the Web User Interface*
- *Using the Cisco WCS User Interface*

Using the Web User Interface

When you wish to convert a Cisco WLAN Solution from Layer 2 to Layer 3 LWAPP Transport Mode using the Web User Interface, complete the following steps:

CAUTION: This procedure will cause your Cisco 1000 Series lightweight access points to go offline until the Cisco Wireless LAN Controller reboots and the associated Cisco 1000 Series lightweight access points reassociate with the Cisco Wireless LAN Controller.

Note: Layer 3 Mode requires that all subnets that the Cisco Wireless LAN Controllers are connected to include at least one DHCP server. When you have completed this procedure, the Cisco Wireless LAN Controller stores its IP address in its associated Cisco 1000 Series lightweight access points. When each Cisco 1000 Series light-weight access point is powered up, it obtains an IP address from the local DHCP server, and connects to its Primary, Secondary, or Tertiary Cisco Wireless LAN Controller.

Note: Layer 3 Mode requires that all subnets that contain Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are routable to each other.

1. To use the Cisco WLAN Solution in Layer 3 mode, you must create an AP Manager Interface, which manages communications between each Cisco Wireless LAN Controller and its associated Cisco 1000 Series lightweight access points. This AP Manager Interface will require a fixed IP address, which must be different from the Management Interface IP address, but which can be on the same subnet as the Management Interface.
2. MAKE SURE that all the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on the same subnet: that they are only connected through Layer 2 devices.

   CAUTION: This step is very important! You must configure the Cisco Wireless LAN Controllers and associated Cisco 1000 Series lightweight access points to operate in Layer 3 mode BEFORE completing the conversion.

3. Verify that the Cisco 1000 Series lightweight access points are assigned to the desired Cisco Wireless LAN Controller. If you do not complete this step, the Cisco 1000 Series lightweight access points will fail to associate with the Cisco Wireless LAN Controller after completing the conversion.
   A. In the Web User Interface, select **WIRELESS / Cisco APs** to navigate to the **Cisco APs** page, and click **Detail** to have the Web User Interface display the **Cisco APs > Details** page.
   B. On the Cisco APs > Details page for each Cisco 1000 Series lightweight access point, verify that the **Primary, Secondary,** and **Tertiary Controller Names** are correct. If you change the Primary, Secondary, or Tertiary Controller Names, click **Apply** to save the change to the Cisco 1000 Series lightweight access point.

4. Select **WIRELESS / Cisco APs** to navigate to the **Cisco APs** page, and MAKE SURE that all the Cisco 1000 Series lightweight access points are listed before you continue with the next step.

   If you do not complete this step, the Cisco 1000 Series lightweight access points may fail to associate with the Cisco Wireless LAN Controller after completing the conversion.

5. Change the LWAPP Transport Mode from Layer 2 to Layer 3:

   A. Select **CONTROLLER / General** to navigate to the General page, and change Layer 2 LWAPP Transport Mode to **Layer 3**.

   B. Click **Apply** to send the changes to the Cisco Wireless LAN Controller and the associated Cisco 1000 Series lightweight access points. Click **OK** to continue.

6. Select **COMMANDS / Reboot** to navigate to the System Reboot page, and click **Reboot** to display the Reboot System > Save? page.

7. In the Reboot System > Save? page, click Save and Reboot to have the Operating System save the new configuration to and reboot the Cisco Wireless LAN Controller.

   The Cisco Wireless LAN Controller reboots.

8. Select **CONTROLLER / Interfaces** to navigate to the **Interfaces** page, and verify that the Operating System has automatically added the **ap-manager** interface.

9. Configure the ap-manager interface. In the Interfaces page, click the ap-manager Interface **Edit** button to have the Web User display the **Interfaces > Edit** page. In the Interfaces > Edit page:

   - Optionally add a **VLAN Identifier**.
   - Enter the **ap-manager IP Address** and **Netmask** obtained in Step 1.
   - Add a **Gateway IP address**.
   - Enter the **physical port number** for the Distribution System connection to the Cisco Wireless LAN Controller.
   - Enter a **Primary DHCP Server IP address**.
   - Enter a **Secondary DHCP Server IP address**. (This can be the same as the Primary DHCP Server IP address if you do not have a second DHCP server on this subnet.)
   - Optionally select an **ACL** (Access Control List) from the drop-down menu.
   - Click **Apply** to add the edited AP Manager Interface definition to the list of interfaces.

10. From the **Interfaces** page, verify that the **management** interface is properly configured with a different IP Address than the **ap-manager** interface.

11. Save the new configuration and restart your Cisco Wireless LAN Controller:

    A. Select **COMMANDS / Reboot** to navigate to the **System Reboot** page, and select **Reboot**.

    B. On the Reboot System > Save page, click **Save and Reboot** to save the changes to and reboot the Cisco Wireless LAN Controller.

    C. Click **OK** to confirm the save and reboot.

12. After the Cisco Wireless LAN Controller has rebooted, select **CONTROLLER / General** to navigate to the **General** page, and verify that the LWAPP Transport Mode is set to **Layer 3**.

13. Power down each Cisco 1000 Series lightweight access point to save the Layer 3 configuration to nonvolatile memory.

14. Connect each Cisco 1000 Series lightweight access point to its final location in the network. Each Cisco 1000 Series lightweight access point connects to its Primary, Secondary, or Tertiary Cisco Wireless LAN Controller, downloads a copy of the latest Operating System code, and starts reporting its status to the Cisco Wireless LAN Controller. Note that this can take a few minutes for each Cisco 1000 Series lightweight access point.

You have completed the LWAPP Transport Mode conversion from Layer 2 to Layer 3. The **ap-manager** interface now controls all communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points on different subnets. Continue with the *Product Guide*.

Using the Cisco WCS User Interface

When you wish to convert a Cisco WLAN Solution from Layer 2 to Layer 3 LWAPP Transport Mode using the Cisco WCS User Interface, complete the following steps:

CAUTION: This procedure will cause your Cisco 1000 Series lightweight access points to go offline until the Cisco Wireless LAN Controller reboots and the associated Cisco 1000 Series lightweight access points reassociate with the Cisco Wireless LAN Controller.

Note: Layer 3 Mode requires that all subnets that the Cisco Wireless LAN Controllers and are connected to include at least one DHCP server. When you have completed this procedure, the Cisco Wireless LAN Controller stores its IP address in its associated Cisco 1000 Series lightweight access points. When each Cisco 1000 Series lightweight access point is powered up, it obtains an IP address from the local DHCP server, and connects to its Primary, Secondary, or Tertiary Cisco Wireless LAN Controller.

Note: Layer 3 Mode requires that all subnets that contain Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are routable to each other.

1. To use the Cisco WLAN Solution in Layer 3 mode, you will need to create an AP Manager Interface, which manages communications between each Cisco Wireless LAN Controller and its associated Cisco 1000 Series lightweight access points. This AP Manager Interface will require a fixed IP address, which must be different from, but which must be on the same subnet as the Management Interface.
2. MAKE SURE that all the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on the same subnet: that they are only connected through Layer 2 devices.

   CAUTION: This step is very important! You must configure the Cisco Wireless LAN Controllers and associated Cisco 1000 Series lightweight access points to operate in Layer 3 mode BEFORE completing the conversion.

3. In the Cisco WCS User Interface, select **CONFIGURE/Access Points** to navigate to the **All Access Points** page, and verify that the **Primary, Secondary,** and **Tertiary Controller Names** are correct for all Cisco 1000 Series lightweight access points. If you change the Primary, Secondary, or Tertiary Controller Names, click **Apply** to save the change to each Cisco 1000 Series lightweight access point.
4. Select **CONFIG/Access Points** to navigate to the **All Access Points** page, and MAKE SURE that the Cisco 1000 Series lightweight access points are associated with the Cisco Wireless LAN Controller before you continue with the next step.

   If you do not complete this step, the Cisco 1000 Series lightweight access points may fail to associate with the Cisco Wireless LAN Controller after completing the conversion.

5. Change the LWAPP Transport Mode from Layer 2 to Layer 3:
   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page, and select the Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **< IP address > > Controller General** page.
   B. From the <IP address> > Controller General page, select **System / Networking** to display the **< IP address > > Networking Setups** page.
   C. On the <IP address> > Networking Setups page, change Layer 2 LWAPP Transport Mode to **Layer 3** and click **Save**.
   D. Cisco WCS displays a `Please reboot the system for the LWAPP Mode change to take effect` message; click **OK**.
6. Create a new AP Manager Interface:
   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page, and select the desired Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **< IP address > > Controller General** page.
   B. In the <IP address> > Controller General page, select **System / Interfaces** to have Cisco WCS display the **< IP address > > Interface** page.
   C. In the <IP address> > Interface page, select **System / Interfaces** and then click **GO** to have Cisco WCS display a second **< IP address > > Interface** page.
      > Add an Interface Name **ap manager**.
      > Enter the **AP Manager IP Address** obtained in Step 1.
      > Optionally add a **VLAN ID**.
      > Add a **Gateway IP address**.
      > Enter the **physical port number** for the Distribution System connection to the Cisco Wireless LAN Controller.
      > Enter a **Primary DHCP Server IP address**.
      > Enter a **Secondary DHCP Server IP address**. (This can be the same as the Primary DHCP Server IP address if you do not have a second DHCP server on this subnet.)
      > Optionally select an **ACL** (Access Control List) from the drop-down menu.
      > Click **Save** to add the AP Manager Interface to the list of interfaces.
   D. Use the browser **Back** button (ALT-Left Arrow) to return to the first **< IP address > > Interface** page, and verify that Cisco WCS has added the **ap manager** Interface Name to the list of Interfaces.
7. From the first **< IP address > > Controller General** page, verify that the **management** interface is properly configured with a different IP Address than the **ap manager** interface.
8. Save the new configuration and restart your Cisco Wireless LAN Controller:
   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page.
   B. Select the Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **< IP address > > Controller General** page.
   C. From the <IP address> > Controller General page, select **System / Commands** to display the **< IP address > > Controller Commands** page.
   D. On the <IP address> > Controller Commands page, under Administrative Commands, select **Save Config to Flash** and click **GO** to save the changed configuration to the Cisco Wireless LAN Controller.

E. On the <IP address> > Controller Commands page, under Administrative Commands, select **Reboot** and click **GO** to reboot the Cisco Wireless LAN Controller. Then click **OK** to confirm the save and reboot.

9. After the Cisco Wireless LAN Controller has rebooted, verify that the LWAPP Transport Mode is now Layer 3:

   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page, and select the desired Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **<IP address> > Controller General** page.

   B. From the <IP address> > Controller General page, select **System / Networking** to display the **<IP address> > Networking Setups** page.

   C. On the <IP address> > Networking Setups page, verify that the Current LWAPP Transport Mode is **Layer 3**.

10. Select **CONFIGURE / Access Points** to navigate to the **All Access Points** page, and MAKE SURE that the Cisco 1000 Series lightweight access points are associated with the Cisco Wireless LAN Controller before you continue with the next step. If you do not complete this step, the Cisco 1000 Series lightweight access points may fail to associate with the desired Cisco Wireless LAN Controller after completing the conversion.

11. Power down each Cisco 1000 Series lightweight access point to save the Layer 3 configuration to nonvolatile memory.

12. Connect each Cisco 1000 Series lightweight access point to its final location in the network. Each Cisco 1000 Series lightweight access point connects to its Primary, Secondary, or Tertiary Cisco Wireless LAN Controller, downloads a copy of the latest Operating System code, and starts reporting its status to the Cisco Wireless LAN Controller. Note that this can take a few minutes for each Cisco 1000 Series lightweight access point.

You have completed the LWAPP Transport Mode conversion from Layer 2 to Layer 3. The **ap-manager** interface now controls all communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points on different subnets. Continue with the *Product Guide*.

Converting a Cisco WLAN Solution from Layer 3 to Layer 2 Mode

When you wish to convert Cisco WLAN Solution from Layer 3 to Layer 2 Mode, perform one of the following tasks:

- *Using the Web User Interface*
- *Using the Cisco WCS User Interface*

Using the Web User Interface

When you wish to convert a Cisco WLAN Solution from Layer 3 to Layer 2 LWAPP Transport Mode using the Web User Interface, complete the following steps:

> **CAUTION:** This procedure will cause your Cisco 1000 Series lightweight access points to go offline until the Cisco Wireless LAN Controller reboots and the associated Cisco 1000 Series lightweight access points reassociate with the Cisco Wireless LAN Controller.

1. MAKE SURE that all the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on the same subnet: that they are only connected through Layer 2 devices.

   > **CAUTION:** This step is very important! If you change the Cisco WLAN Solution From Layer 3 to Layer 2 while the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on different subnets, they will be UNABLE TO COMMUNICATE with each other after the conversion to Layer 2 mode.

2. In the Web User Interface, select **CONTROLLER / General** to navigate to the **General** page, and change Layer 3 LWAPP Transport Mode to **Layer 2**. Then click **Apply** to send the changes to the Cisco Wireless LAN Controller. Click **OK** to continue.
3. Select **COMMANDS / Reboot** to navigate to the **System Reboot** page, and select **Reboot**. On the **Reboot System > Save** page, click **Save and Reboot** to save the changes to and to reboot the Cisco Wireless LAN Controller. Then click **OK** to confirm the save and reboot.
4. After the Cisco Wireless LAN Controller has rebooted, select **CONTROLLER / General** to navigate to the General page, and verify that the current LWAPP Transport Mode is set to **Layer 2**.
5. Also select **CONTROLLER / Interfaces** to navigate to the Interfaces page, and verify that the **ap-manager** interface is removed from the list of Interface Names.

You have completed the LWAPP Transport Mode conversion from Layer 3 to Layer 2. The Operating System software now controls all communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points on the same subnet. Continue with the *Product Guide*.

Using the Cisco WCS User Interface

When you wish to convert a Cisco WLAN Solution from Layer 3 to Layer 2 LWAPP Transport Mode using the Cisco WCS User Interface, complete the following steps:

> **CAUTION:** This procedure causes your Cisco 1000 Series lightweight access points to go offline until the Cisco Wireless LAN Controller reboots and the associated Cisco 1000 Series lightweight access points reassociate with the Cisco Wireless LAN Controller.

1. MAKE SURE that all the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on the same subnet: that they are only connected through Layer 2 devices.

   > **CAUTION:** This step is very important! If you change the Cisco WLAN Solution From Layer 3 to Layer 2 while the Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points are on different subnets, they will be UNABLE TO COMMUNICATE with each other after the conversion to Layer 2 mode.

2. In the Cisco WCS User Interface, change the LWAPP Transport Mode from Layer 3 to Layer 2:
   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page, and select the Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **< IP address> > Controller General** page.
   B. On the <IP address> > Controller General page, select **System / Networking** to display the **< IP address> > Networking Setups** page.
   C. On the <IP address> > Networking Setups page, change Layer 3 LWAPP Transport Mode to **Layer 2** and click **Save**.
   D. Cisco WCS may display a `Please reboot the system for the LWAPP Mode change to take effect` message; if so, click **OK**.
3. Restart your Cisco WLAN Solution:
   A. On the <IP address> > Networking Setups page, select **System / Commands** to display the **< IP address> > Controller Commands** page.
   B. On the <IP address> > Controller Commands page, under Administrative Commands, select **Save Config to Flash** and click **GO** to save the changed configuration to the Cisco Wireless LAN Controller. Click **OK** to continue.
   C. On the <IP address> > Controller Commands page, under Administrative Commands, select **Reboot** and click **GO** to reboot the Cisco Wireless LAN Controller. Then click **OK** to confirm the save and reboot.
4. After the Cisco Wireless LAN Controller has rebooted, verify that the LWAPP Transport Mode is now Layer 2:
   A. Select **CONFIGURE / Controllers** to navigate to the **All Controllers** page, and select the Cisco Wireless LAN Controller by IP address to have Cisco WCS display the **< IP address> > Controller General** page.
   B. On the <IP address> > Controller General page, select **System / Networking** to display the **< IP address> > Networking Setups** page.
   C. On the <IP address> > Networking Setups page, verify that the LWAPP Transport Mode is set to **Layer 2**.

You have completed the LWAPP Transport Mode conversion from Layer 3 to Layer 2. The Operating System software will now control all communications between Cisco Wireless LAN Controllers and Cisco 1000 Series lightweight access points on the same subnet. Continue with the *Product Guide*.

Configuring a Firewall for Cisco WCS

When a Cisco WCS Server and a Cisco WCS User Interface are on different sides of a firewall, they cannot communicate unless the following ports on the firewall are opened to two-way traffic:

- 80 (TCP)
- 1299 (TCP)
- 4000 (TCP)
- 5009 (TCP)
- 5010 (TCP)
- 6789 (RMI)

Open these ports to configure your firewall to allow communications between a Cisco WCS Server and a Cisco WCS User Interface.

Refer to the Cisco WCS Software Release Notes for any other ports that need to be opened for a Cisco WCS Server-to-Cisco WCS User Interface communications.

Continue with the *Product Guide*.

Configuring the System for SpectraLink NetLink Telephones

SpectraLink NetLink Telephones require an extra Operating System configuration step to optimize integration with Operating System. That configuration step is to enable long preambles in the Operating System:

- *Using the Command Line Interface*
- *Using the Web User Interface*
- *Using the Cisco Wireless Control System*

Using the Command Line Interface

Use this procedure to optimize the Operating System to communicate with SpectraLink NetLink Telephones using a long preamble.

- Log into the command line interface as described in *Logging Into the CLI*.
- Use the **show 802.11b** command to view the following parameter:

  ```
  Short Preamble mandatory..... Enabled
  ```

  which shows the Operating System default, Short Preamble Enabled; if this is the case, continue with this procedure.

  If this parameter indicates Short Preamble Disabled, this Cisco Wireless LAN Controller is already optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.
- Disable the 802.11b/g network using the **config 802.11b disable network** command.
- Enable long preambles using the **config 802.11b preamble long** command.
- Enable the 802.11b/g network using the **config 802.11b enable network** command.
- Reboot the Cisco Wireless LAN Controller using the **reset system** command.

  Answer **y** to the `The system has unsaved changes. Would you like to save them now? (y/n)` prompt.
- The Cisco Wireless LAN Controller reboots.
- Verify that the Cisco Wireless LAN Controller is properly configured by logging back into the CLI and using the **show 802.11b** command to view the following parameters:

  ```
  802.11b Network.............................. Enabled
  Short Preamble mandatory..... Disabled
  ```

  which shows that the 802.11b/g Network is Enabled and the Short Preamble is Disabled (Long Preamble is Enabled).
- This Cisco Wireless LAN Controller is now optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.

Using the Web User Interface

Use this procedure to optimize the Operating System to communicate with SpectraLink NetLink Telephones using a long preamble.

- Log into the Web User Interface as described in *Using the Web User Interface*.
- Use **Wireless / Global RF / 802.11b/g Network** to view the 802.11b/g Global Parameters page.

- When the `Short Preamble Enabled` box is checked, the Operating System is set to the default, Short Preamble Enabled; if this is the case, continue with this procedure.

  If this parameter indicates that Short Preamble is Disabled (box is unchecked), this Cisco Wireless LAN Controller is already optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.

- Enable long preambles by unchecking the `Short Preamble Enabled` box.
- Click the **Apply** button to update the Cisco Wireless LAN Controller.

  Note: If you do not already have a CLI session active, Cisco strongly recommends that you start a CLI session to reboot the Cisco Wireless LAN Controller with Save and watch the reboot process. Another reason to use the CLI is that the Web User interface loses its connection when the Cisco Wireless LAN Controller reboots.

- If you decide to reboot the Cisco Wireless LAN Controller using the CLI, continue with the Reboot and Verify steps found in the *Using the Command Line Interface* section. Otherwise, continue with this section.
- Reboot the Cisco Wireless LAN Controller using **Commands / Reboot / Reboot**.

  Click **OK** in response to the `Configuration will be saved and switch will be rebooted. Click ok to confirm.` prompt.

- The Cisco Wireless LAN Controller reboots.
- Verify that the Cisco Wireless LAN Controller is properly configured by logging back into the Web User Interface and using the **Wireless / Global RF / 802.11b/g Network** command to view the 802.11b/g Global Parameters page.
- When the `Short Preamble Enabled` box is unchecked, this Cisco Wireless LAN Controller is optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.

Using the Cisco Wireless Control System

Use this procedure to optimize the Operating System to communicate with SpectraLink NetLink Telephones using a long preamble.

- Log into the Cisco Wireless Control System using the Cisco WCS User Interface as described in *Starting a Cisco WCS User Interface*.
- Navigate to the **Configuration / Configure Controllers / <Cisco Wireless LAN Controller IP Address> / 802.11b/g / 802.11b/g Params** page.
- When **Short Preamble** is Enabled, the Operating System is set to the default, Short Preamble Enabled; if this is the case, continue with this procedure.

  If this parameter shows Short Preamble Disabled, this Cisco Wireless LAN Controller is already optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.

- Enable long preambles by setting **Short Preamble** to Disabled.
- Click the **Apply** button to update the Cisco Wireless LAN Controller.
- Save the Cisco Wireless LAN Controller configuration using the **Controller Config/Save Config** command.
- Reboot the Cisco Wireless LAN Controller using **Controller Commands/Reboot**.

  Click **OK** in response to the `Please save configuration by clicking 'Save Config' under 'Switch Config' menu. Do you want to continue Rebooting anyway?` prompt.

- The Cisco Wireless LAN Controller reboots. This will take some time, during which Cisco WCS loses its connection to the Cisco Wireless LAN Controller.

  Note: You can use a CLI session to view the Cisco Wireless LAN Controller reboot process. When you can log into the Cisco Wireless LAN Controller CLI, continue with this procedure.

- Verify that the Cisco Wireless LAN Controller is properly configured by navigating to the **Monitor / Troubleshoot / Controller Status / <Cisco Wireless LAN Controller IP Address> / 802.11b / g / Stats** page.
- On the Stats page, verify that **Short Preamble Implemented** is set to No, which indicates that this Cisco Wireless LAN Controller is optimized for SpectraLink NetLink Telephones; if desired, continue with the *Product Guide*.

Using Management over Wireless

The Cisco WLAN Solution Management over Wireless feature allows Cisco WLAN Solution operators to monitor and configure their local Cisco Wireless LAN Controller using a wireless client. This feature is supported for all management tasks except uploads to and downloads from (transfers to and from) the Cisco Wireless LAN Controller.

Before you can use the Management over Wireless feature, you must properly configure the Cisco Wireless LAN Controller using either of the following two sections:

- *Using the Command Line Interface*
- *Using the Web User Interface*

Using the Command Line Interface

1. In the CLI, use the **show network** command to verify whether the `Mgmt Via Wireless Interface` is `Enabled` or `Disabled`. If `Mgmt Via Wireless Interface` is `Disabled`, continue with Step 2. Otherwise, continue with Step 3.
2. To Enable Management over Wireless, use the following command:

   >config network mgmt-via-wireless enable

   to enable Management over Wireless for the WLAN.
3. Use a wireless client to associate with a Cisco 1000 Series lightweight access point connected to the Cisco Wireless LAN Controller you wish to manage.
4. Use the **telnet < Cisco Wireless LAN Controller Network or DS Port IP Address>** command and log into the CLI to verify that you can manage the WLAN using a wireless client.

Using the Web User Interface

1. In the Web User Interface, use the **Management/Mgmt Via Wireless** links to navigate to the **Management Via Wireless** page.
2. In the **Management Via Wireless** page, verify that the **Enable Controller Management to be accessible from Wireless Clients** selection box is checked. If the selection box is not checked, continue with Step 2. Otherwise, continue with Step 3.
3. In the **Management Via Wireless** page, check the **Enable Controller Management to be accessible from Wireless Clients** selection box to select Management over Wireless for the WLAN.
4. Click **Apply** to enable Management over Wireless for the WLAN.
5. Use a wireless client web browser to connect to the Cisco Wireless LAN Controller Management Port or DS Port IP Address, and log into the Web User Interface to verify that you can manage the WLAN using a wireless client.

Configuring a WLAN for a DHCP Server

Using the Command Line Interface

1. In the CLI, use the **show wlan** command to verify whether you have a valid DHCP server assigned to the WLAN. If you have no DHCP server assigned to the WLAN, continue with Step 2. Otherwise, continue with Step 4.
2. If necessary, use the following commands:

   >config wlan disable <WLAN id>

   >config wlan dhcp_server <WLAN id> <DHCP IP Address>

   >config wlan enable <WLAN id>

   where <WLAN id> = 1 through 16, and <DHCP IP Address> = DHCP server IP Address.
3. Use the **show wlan** command to verify that you have a DHCP server assigned to the WLAN.
4. Use the **ping <DHCP IP Address>** command to verify that the WLAN can communicate with the DHCP server.

Using the Web User Interface

1. In the Web User Interface, navigate to the **WLANs** page.
2. Locate the WLAN which you wish to configure for a DHCP server, and click the associated **Edit** link to display the **WLANs > Edit** page.
3. Under **General Policies**, check the **DHCP Relay / DHCP Server IP Addr** to verify whether you have a valid DHCP server assigned to the WLAN. If you have no DHCP server assigned to the WLAN, continue with Step 4. Otherwise, continue with Step 9.
4. Under **General Policies**, deselect the **Admin Status Enabled** box.
5. Click **Apply** to disable the WLAN.
6. In the **DHCP Relay / DHCP Server IP Addr** box, enter a valid DHCP server IP Address for this WLAN.
7. Under **General Policies**, select the **Admin Status Enabled** box.
8. Click **Apply** to assign the DHCP server to the WLAN and to enable the WLAN. You are returned to the **WLANs** page.
9. In the upper-right corner of the **WLANs** page, click **Ping** and enter the DHCP server IP Address to verify that the WLAN can communicate with the DHCP server.

Customizing the Web Auth Login Screen

When a Cisco system operator uses Web Authorization (Web Auth) to authenticate clients, the operator must define User Names and Passwords for each client, and then the clients must enter a valid username and password when prompted. Because the Cisco WLAN Solution operator may want to customize the Web Auth Login screen, the following two sections describe the default operation and how to customize the Web Auth Login screen.

- *Default Web Auth Operation*
- *Customizing Web Auth Operation*
- *Sample Customized Web Auth Login Page*

Default Web Auth Operation

When the network operator uses Web Authorization (Web Auth) to authorize clients, the first time clients attempt to access a URL they may receive a Security Alert from their web browser similar to the following:

Figure - Typical Security Alert

Security Alert
Information you exchange with this site cannot be viewed or changed by others. However, there is a problem with the site's security certificate.
The security certificate was issued by a company you have not chosen to trust. View the certificate to determine whether you want to trust the certifying authority.
The security certificate date is valid.
The security certificate has a valid name matching the name of the page you are trying to view.
Do you want to proceed?
Yes
No
View Certificate
09100301

After answering Yes to the **Do you want to Proceed?** prompt or if there is no Security Alert, Operating System redirects the client to a Login screen that the client must use to log in using an authorized username and password.

The client must respond with a username and password predefined using the Local Net Users > New Web User page, or using the config netuser add command line interface (CLI) command.

Note that the Default Cisco WLAN Solution Login Screen contains Cisco WLAN Solution-specific text and a logo in four customizable areas:

- The Cisco WLAN Solution logo in the upper-right corner can be deleted and restored.
- The Web Title “Welcome to the Cisco WLAN Solution wireless network.”

- The Web Message “Cisco WLAN Solution is pleased to provide the Wireless LAN infrastructure for your network. Please login and put your air space to work.”
- A blank area on the right side of the screen for a user-supplied Logo or other graphic.

The Cisco WLAN Solution logo, Web Title, Web Message, and Logo can be customized for each Cisco WLAN Solution as described in the *Customizing Web Auth Operation* section.

When the client has entered a valid username and password, Operating System typically displays some version of the following Login Successful page, and then redirects the authenticated client to the originally-requested URL.

Figure - Default Login Successful Screen

Web Authentication
Login Successful !
You can now use all regular network services over the wireless network.
Please retain this small logout window in order to logoff when done. Note that you can always use the following URL to retrieve this page:
https://1.1.1.1/logout.html
Logout
03100303

Note that the Default Login Successful Screen contains a pointer to the operator-defined Virtual Gateway Address URL, redirect https://1.1.1.1/logout.html. This redirect is defined by the Virtual Gateway IP Address parameter (1.1.1.1) entered while *Using the Startup Wizard*, as the Virtual Gateway Address in the Interfaces Web User page, or using the config interface create command line interface (CLI) command.

Also note that the Cisco WLAN Solution operator may want to redirect the authenticated client to a different URL. This is described in the *Customizing Web Auth Operation* section.

Customizing Web Auth Operation

You can customize Web Auth operation *Using the Cisco WLAN Solution CLI* commands as follows:

- *Clearing and Restoring the Cisco WLAN Solution Logo*
- *Changing the Web Title*
- *Changing the Web Message*
- *Changing the Logo*
- *Creating a Custom URL Redirect*
- *Verifying your Web Auth Changes*
- *Sample Customized Web Auth Login Page*

Clearing and Restoring the Cisco WLAN Solution Logo

You can delete or restore the Cisco WLAN Solution logo shown in the *Default Web Auth Operation* section using the config custom-web weblogo command:

```
>config custom-web weblogo <disable/enable>
```

Refer to the *Sample Customized Web Auth Login Page* for an example.

Changing the Web Title

You can change the Web Title shown in the *Default Web Auth Operation* section using the config custom-web webtitle command:

```
>config custom-web webtitle <string>
```

To change the Web Title again, enter the config custom-web webtitle command again with a new <string>. Refer to the *Sample Customized Web Auth Login Page* for an example.

To change the Web Title back to the Cisco WLAN Solution default “Welcome to the Cisco WLAN Solution wireless network”, use the clear webtitle command:

```
>clear webtitle
```

Changing the Web Message

You can change the Web Message shown in the *Default Web Auth Operation* section using the config custom-web webmessage command:

```
>config custom-web webmessage <string>
```

To change the Web Message again, enter the config custom-web webtitle command again with a new <string>. Refer to the *Sample Customized Web Auth Login Page* for an example.

To change the Web Message back to the Cisco WLAN Solution default “Cisco WLAN Solution is pleased to provide the Wireless LAN infrastructure for your network. Please login and put your air space to work.”, use the clear webmessage command:

```
>clear webmessage
```

Changing the Logo

You can add or change a Logo or other graphic in the right side of the Web Auth Login screen as described in the *Default Web Auth Operation* section using the following instructions.

- *Preparing the TFTP Server*
- *Copying the Logo or Graphic to the TFTP Server*
- *Downloading the Logo or Graphic*

Preparing the TFTP Server

- Make sure you have a TFTP server available for the Logo or Graphic image download.
  - If you are downloading through the Service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - If you are downloading through the DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.
- In the CLI, use the **ping <IP Address>** command to ensure the Cisco Wireless LAN Controller can contact the TFTP server.

  Note: The TFTP server cannot run on the same computer as the *Cisco Wireless Control System*, because the Cisco WCS and the TFTP server use the same communication port.

Copying the Logo or Graphic to the TFTP Server

- Create a Logo or Graphic image in .JPG, .GIF, or .PNG format with a maximum size of 30 kilobits (recommended size of 180 W x 360 H pixels).
- Make sure the Logo or Graphic image filename contains no spaces.
- Copy the desired Logo or Graphic image file to the default directory on your TFTP server.

Downloading the Logo or Graphic

- In the CLI, use the **transfer download start** command, and answer 'n' to the prompt to view the current download settings:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Code
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename.............................. <filename.jpg|.gif|.png>

Are you sure you want to start? (y/n) n

Transfer Canceled

>
```

- To change the download settings, use the following:

```
>transfer download mode tftp

>transfer download datatype image

>transfer download serverip <TFTP server IP address>

>transfer download filename <filename.gif|filename.jpg|filename.png>

>transfer download path <absolute TFTP server path to the update file>
```

> **Note:** Some TFTP servers require only a forward slash "/" as the **<TFTP server IP address>,** and the TFTP server automatically determines the path to the correct directory.

- In the CLI, use the **transfer download start** command to view the updated settings, and answer 'y' to the prompt to confirm the current download settings and start the Operating System code download:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Login Image
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename............................ <filename.jpg|.gif|.png>

This may take some time.
Are you sure you want to start? (y/n) y

TFTP Image transfer starting.

Image installed.
```

To change the Logo or Graphic image again, repeat these commands again using a new filename. Refer to the *Sample Customized Web Auth Login Page* for an example.

To remove the Logo or Graphic image from the Web User Login screen, use the clear webimage command:

```
>clear webimage
```

Creating a Custom URL Redirect

To have Operating System redirect all clients to a specific URL (including http:// or https://) after Web Authentication, use the config custom-web redirect url command:

```
>config custom-web redirecturl <URL>
```

To change the Web Message again, enter the config custom-web redirect-url command again with a new <URL>.

For example, if you want to redirect all clients to www.AcompanyBC.com, use the following command:

```
>config custom-web redirecturl www.AcompanyBC.com
```

To change the redirect back to the originally-requested URL, use the clear redirect-url command:

```
>clear redirecturl
```

Verifying your Web Auth Changes

Use the show custom-web command to verify your Web Auth operation changes:

Default State

```
>show custom-web

Cisco Logo.............................. Enabled
CustomLogo.............................. Disabled
Custom Title............................ Disabled
Custom Message.......................... Disabled
Custom Redirect URL..................... Disabled
External Web Authentication Mode........ Disabled
External Web Authentication URL......... Disabled
```

Typical Modified State

```
>show custom-web

Cisco Logo.............................. Disabled
CustomLogo.............................. 00_logo.gif
Custom Title............................ Welcome to the AcompanyBC Wireless LAN!
Custom Message.......................... Contact the System Administrator for a
Username and Password.
Custom Redirect URL..................... http://www.AcompanyBC.com
External Web Authentication Mode........ Disabled
External Web Authentication URL......... Disabled
```

Sample Customized Web Auth Login Page

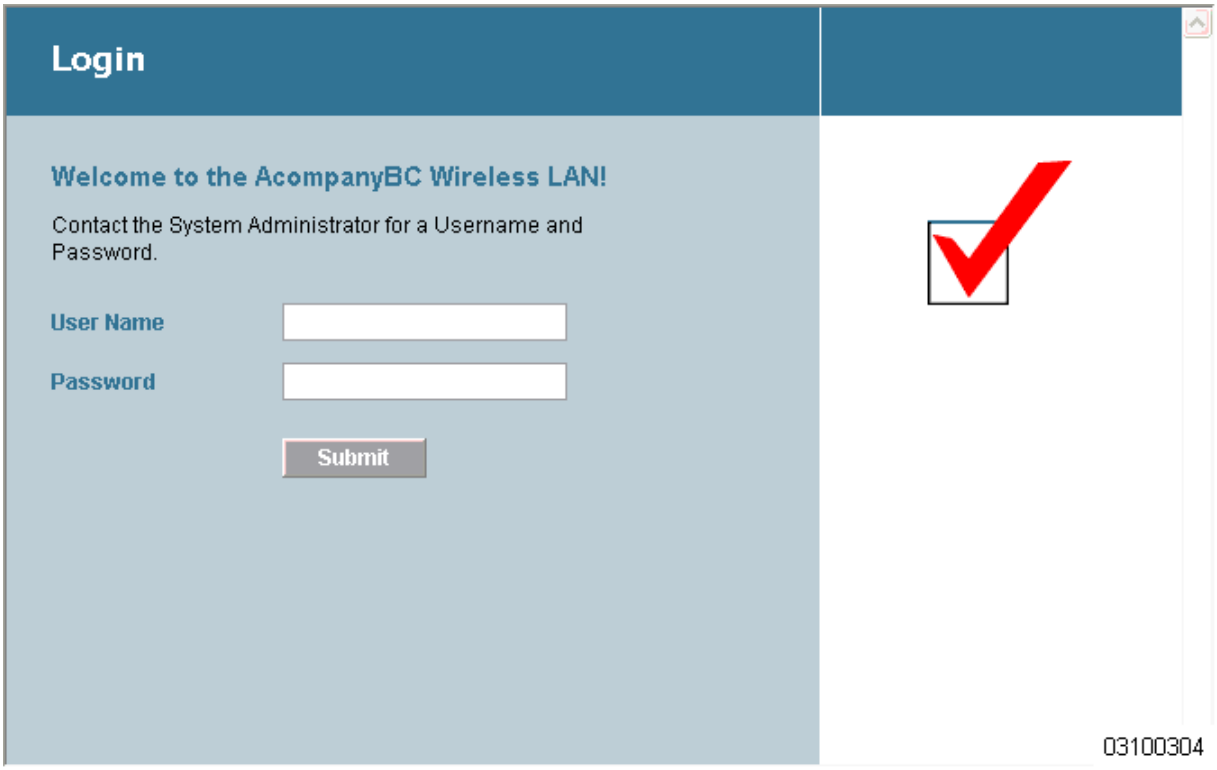
Here is a sample of a customized Web Auth Login page, and the commands used to create it:

```
>config custom-web weblogo disable

>config custom-web webtitle Welcome to the AcompanyBC Wireless LAN!

>config custom-web webmessage Contact the System Administrator for a Username
and Password.

>transfer download start

Mode.................................... TFTP
Data Type............................... Login Image
TFTP Server IP.......................... xxx.xxx.xxx.xxx
TFTP Path............................... /
TFTP Filename........................... Logo.gif
```

```
This may take some time.
Are you sure you want to start? (y/n) y
TFTP Image transfer starting.
Image installed.
>config custom-web redirecturl http://www.AcompanyBC.com
>show custom-web
Cisco Logo.............................. Disabled
CustomLogo.............................. 00_logo.gif
Custom Title............................ Welcome to the AcompanyBC Wireless LAN!
Custom Message.......................... Contact the System Administrator for a
Username and Password.
Custom Redirect URL..................... http://www.AcompanyBC.com
External Web Authentication Mode........ Disabled
External Web Authentication URL......... Disabled
```

When a client attempts to connect to a URL, the following customized Web Auth screen appears:

Figure - Sample Customized Login Screen



After a successful Web Authorization, the client is redirected to the http://www.AcompanyBC.com URL.

Configuring Identity Networking for Operating System

This document explains the Identity Networking feature of Operating System, how it is configured and the expected behavior for various security policies.

In previous Operating System releases, each WLAN had a static policy that would be applied to all mobile clients associated with the SSID. Although very powerful, this method has limitations since it requires clients to associate with different SSIDs to inherit different QoS and security policies.

The current Operating System supports Identity Networking, which allows the network to advertise a single SSID, yet allows for specific users to inherit different QoS or security policies based on their user profiles. The specific policies that may be overridden include:

- Quality of Service. When present in a RADIUS Access Accept, the *QoS-Level* value overrides the QoS value specified in the WLAN profile.
- ACL. When the ACL attribute is present in the RADIUS Access Accept, the system applies the *ACL-Name* to the client station after authentication occurs. This overrides any ACLs that are assigned to the interface.
- VLAN. When a VLAN *Interface-Name* or *VLAN-Tag* is present in a RADIUS Access Accept, the system places the client on a specific interface.

  Note: This feature is ONLY available with MAC Filtering, 802.1X and WPA. This feature DOES NOT WORK with Web Auth or IPSec.

- Tunnel Attributes.

  Note: When any of the other RADIUS attributes in this section are returned, the *Tunnel Attributes* must also be returned.

In order for this feature to be enabled, on a per WLAN basis, the Enable AAA Override configuration flag must be enabled.

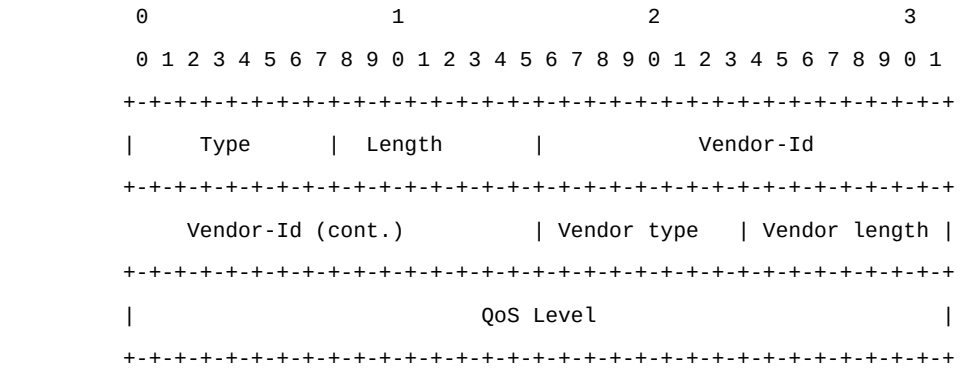
The Operating System's local MAC Filter database has been extended to include the interface name, allowing local MAC filters to specify to which interface the client should be assigned. A separate RADIUS server can also be used, but the RADIUS server must be defined using the Security menus.

The following sections explain the RADIUS attributes.

RADIUS Attributes

QoS-Level

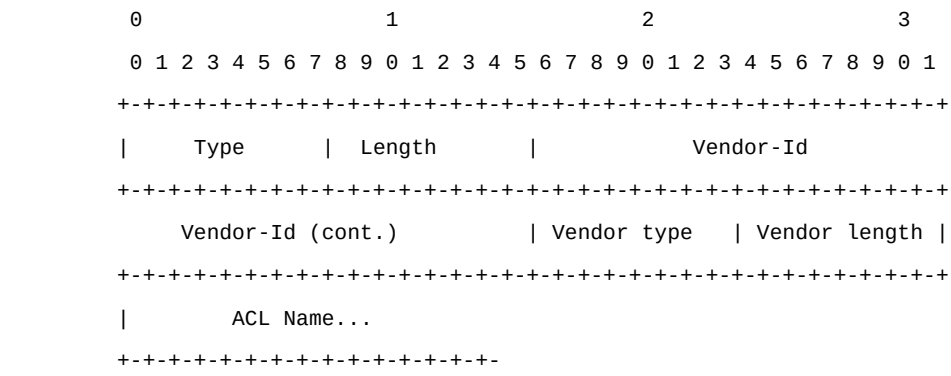
This attribute indicates the Quality of Service level to be applied to the mobile client's traffic within the switching fabric, as well as over the air. A summary of the QoS-Level Attribute format is shown below. The fields are transmitted from left to right.



- Type - 26 for Vendor-Specific
- Length - 10
- Vendor-Id - 14179
- Vendor type - 2
- Vendor length - 4
- Value - Three octets:
  - 0 - Bronze (Background)
  - 1 - Silver (Best Effort)
  - 2 - Gold (Video)
  - 3 - Platinum (Voice)

ACL-Name

This attribute indicates the ACL name to be applied to the client. A summary of the ACL-Name Attribute format is shown below. The fields are transmitted from left to right.

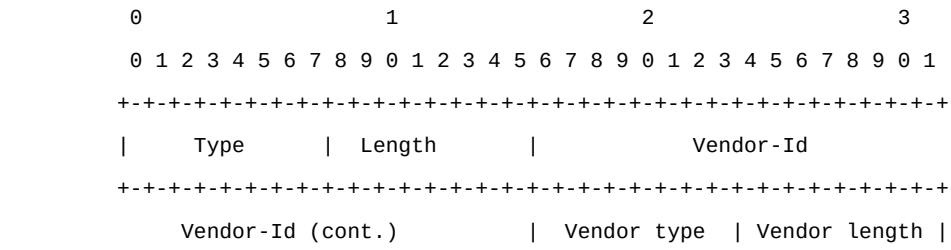


- Type - 26 for Vendor-Specific
- Length - >7
- Vendor-Id - 14179
- Vendor type - 6
- Vendor length - >0
- Value - A string that includes the name of the ACL to use for the client

Interface-Name

This attribute indicates the VLAN Interface a client is to be associated to.

A summary of the Interface-Name Attribute format is shown below. The fields are transmitted from left to right.



```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Interface Name...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-
```

- Type - 26 for Vendor-Specific
- Length - >7
- Vendor-Id - 14179
- Vendor type - 5
- Vendor length - >0
- Value - A string that includes the name of the interface the client is to be assigned to.

> **Note:** This Attribute only works when MAC Filtering is enabled, or if 802.1X or WPA is used as the security policy.

VLAN-Tag

This attribute indicates the group ID for a particular tunneled session, and is also known as the Tunnel-Private-Group-ID attribute.

This attribute MAY be included in the Access-Request packet if the tunnel initiator can predetermine the group resulting from a particular connection and SHOULD be included in the Access-Accept packet if this tunnel session is to be treated as belonging to a particular private group. Private groups may be used to associate a tunneled session with a particular group of users. For example, it may be used to facilitate routing of unregistered IP addresses through a particular interface. It SHOULD be included in Accounting-Request packets which contain Acct-Status-Type attributes with values of either Start or Stop and which pertain to a tunneled session.

A summary of the Tunnel-Private-Group-ID Attribute format is shown below. The fields are transmitted from left to right.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Type     |    Length     |     Tag       |   String...
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Type - 81 for Tunnel-Private-Group-ID.
- Length - >= 3
- Tag - The Tag field is one octet in length and is intended to provide a means of grouping attributes in the same packet which refer to the same tunnel. If the value of the Tag field is greater than 0x00 and less than or equal to 0x1F, it SHOULD be interpreted as indicating which tunnel (of several alternatives) this attribute pertains. If the Tag field is greater than 0x1F, it SHOULD be interpreted as the first byte of the following String field.
- String - This field must be present. The group is represented by the String field. There is no restriction on the format of group IDs.

Tunnel Attributes

> **Note:** When any of the other RADIUS attributes in this section are returned, the Tunnel Attributes must also be returned.

Reference [RFC2868] defines RADIUS tunnel attributes used for authentication and authorization, and [RFC2867] defines tunnel attributes used for accounting. Where the IEEE 802.1X Authenticator supports tunneling, a compulsory tunnel may be set up for the Supplicant as a result of the authentication.

In particular, it may be desirable to allow a port to be placed into a particular Virtual LAN (VLAN), defined in [IEEE8021Q], based on the result of the authentication. This can be used, for example, to allow a wireless host to remain on the same VLAN as it moves within a campus network.

The RADIUS server typically indicates the desired VLAN by including tunnel attributes within the Access-Accept. However, the IEEE 802.1X Authenticator may also provide a hint as to the VLAN to be assigned to the Supplicant by including Tunnel attributes within the Access- Request.

For use in VLAN assignment, the following tunnel attributes are used:

- Tunnel-Type=VLAN (13)
- Tunnel-Medium-Type=802
- Tunnel-Private-Group-ID=VLANID

Note that the VLANID is 12-bits, taking a value between 1 and 4094, inclusive. Since the Tunnel-Private-Group-ID is of type String as defined in [RFC2868], for use with IEEE 802.1X, the VLANID integer value is encoded as a string.

When Tunnel attributes are sent, it is necessary to fill in the Tag field. As noted in [RFC2868], section 3.1:

- The Tag field is one octet in length and is intended to provide a means of grouping attributes in the same packet which refer to the same tunnel. Valid values for this field are 0x01 through 0x1F, inclusive. If the Tag field is unused, it MUST be zero (0x00).
- For use with Tunnel-Client-Endpoint, Tunnel-Server-Endpoint, Tunnel-Private-Group-ID, Tunnel-Assignment-ID, Tunnel-Client-Auth-ID or Tunnel-Server-Auth-ID attributes (but not Tunnel-Type, Tunnel-Medium-Type, Tunnel-Password, or Tunnel-Preference), a tag field of greater than 0x1F is interpreted as the first octet of the following field.
- Unless alternative tunnel types are provided, (e.g. for IEEE 802.1X Authenticators that may support tunneling but not VLANs), it is only necessary for tunnel attributes to specify a single tunnel. As a result, where it is only desired to specify the VLANID, the tag field SHOULD be set to zero (0x00) in all tunnel attributes. Where alternative tunnel types are to be provided, tag values between 0x01 and 0x1F SHOULD be chosen.

Notes:

TASKS

You can perform the following tasks using the Cisco Wireless LAN Solution (Cisco WLAN Solution):

Deployment and Quick Start Guides

- The Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Deployment Guide helps you determine the number of Cisco 1000 Series lightweight access points a site needs, where to place the Cisco 1000 Series lightweight access points, and to perform a minimal site survey, if necessary.
- The Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide provides steps for installing Cisco 1000 Series lightweight access points with internal antennas and no connectors for external antennas.
- The External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide provides steps for installing Cisco 1000 Series lightweight access points with internal antennas and connectors for external antennas.
- The Cisco 4100 Series Wireless LAN Controller Quick Start Guide guides you through installing Cisco 4100 Series Wireless LAN Controller.
- The Windows Cisco WCS Quick Start Guide and Linux Cisco WCS Quick Start Guide give details on how to install Cisco Wireless Control System (Cisco WCS).

OS Command Line Interface (CLI)

- Cisco WLAN Solution CLI Reference describes how to access and use the Cisco WLAN Solution command line interface.
- *Configuring the Cisco Wireless LAN Controller* details how to use the CLI to configure a Cisco Wireless LAN Controller.

Cisco WLAN Solution Switch Web Interface

- *Using the Web User Interface* helps operators access and use the Web User Interface.

Cisco Wireless Control System (Cisco WCS)

- *Using the Cisco Wireless Control System* describes how to access and use the Cisco Wireless Control System.
- *Updating the Operating System Software* provides operators with instructions on how to update a Cisco Wireless LAN Controller (and associated Cisco 1000 Series lightweight access point) OS software.
- *Updating the Windows Cisco WCS* describes how to update Cisco WCS loads on Cisco WCS Windows workstations.
- *Updating the Linux Cisco WCS* describes how to update Cisco WCS loads on Cisco WCS Linux workstations.
- *Reinitializing the Windows Cisco WCS Database* describes how to reinitialize the Cisco WCS database on Cisco WCS Windows workstations.
- *Reinitializing the Linux Cisco WCS Database* describes how to reinitialize the Cisco WCS database on Cisco WCS Linux workstations.
- *Transferring Files To and From a Cisco Wireless LAN Controller* describes uploading and downloading files from a Cisco Wireless LAN Controller.

- *Viewing Network Status* helps you monitor the Cisco WLAN Solution network status.

Cisco 2700 Series Location Appliances

- *Configuring and Operating Cisco 2700 Series Location Appliances*

Troubleshooting

- *Troubleshooting Tips* contains information you can use to troubleshoot the Cisco WLAN Solution.

Using the Cisco WLAN Solution CLI

The Command Line Interface allows operators to configure any Cisco Wireless LAN Controller and its associated Cisco 1000 Series lightweight access points using the command line interface. Refer to the following sections or refer to the Cisco WLAN Solution CLI Reference for more information:

- *Logging Into the CLI*
  - *Using a Local Serial Connection*
  - *Using a Remote Ethernet Connection*
- *Logging Out of the CLI*
- *Navigating the CLI*
- *Using the Startup Wizard*
- *Saving Configurations*
- *Erasing the Cisco Wireless LAN Controller Configuration*
- *Resetting the Cisco Wireless LAN Controller*

Logging Into the CLI

You may access the Cisco Wireless LAN Controller CLI using either of two methods:

- A direct ASCII serial connection to the Cisco Wireless LAN Controller Console Port.
- A remote console session over Ethernet through the pre-configured *Service Port* or *Distribution System Ports* (configured using the appropriate Cisco Wireless LAN Controller Quick Start Guide).

The following sections contain information on how to use the command line interface. This document assumes the Cisco Wireless LAN Controller has been initialized as described in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

Before you log into the command line interface, you must configure your connectivity and environment variables based on the type of connection you are using. Refer to the appropriate section for your connection:

- *Using a Local Serial Connection*
- *Using a Remote Ethernet Connection*

Using a Local Serial Connection

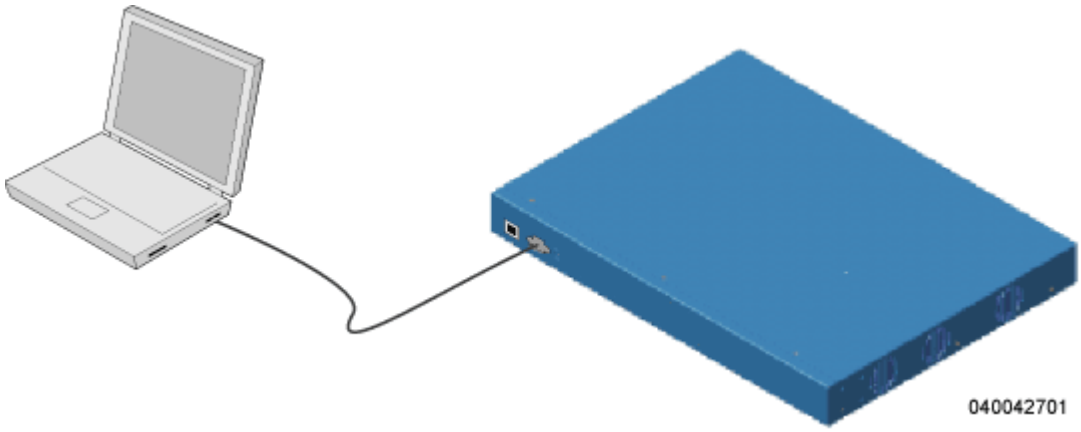
> **Note:** You can use the local serial connection at any time, whether or not the Cisco Wireless LAN Controller has been configured as described in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

You will need:

- A computer running a terminal emulation program and a DB-9 serial port.
- A DB-9 male to female null-modem serial cable.

Use this procedure to configure a serial connection to your Cisco Wireless LAN Controller:

1. Connect your computer to the Cisco Wireless LAN Controller using the DB-9 null-modem serial cable as shown in the following figure.



2. Verify that your terminal emulation (HyperTerminal, ProComm, minicom, tip, or other) interface is configured with the following parameters:
   - 9600 baud
   - 8 data bits
   - 1 stop bit
   - no parity
   - no hardware flow control
3. In your terminal emulation program, open a session with the Cisco Wireless LAN Controller.
4. Press **<RETURN>**. The CLI returns a login prompt.
5. Enter a valid login and password to enter the CLI. (The default login and password are **admin** and **admin**, respectively.)

   ```
   User:
   Password:
   ```

   Note that the login and password functions are case sensitive.
6. The CLI displays the root level system prompt:

   ```
   (system prompt)>
   ```

   The CLI allows a default of five users to be logged in at a time, but this number can be set from zero to five users.

   The system prompt can be any alphanumeric string, up to 31 characters. Because this is a user-defined variable, it is omitted from the rest of this documentation.

   The CLI automatically logs you out without saving any changes after a short period of inactivity. This automatic logout can be set from 0 (never log out), or from 1 to 160 minutes. (Use the CLI command *config serial timeout x*, where x is a number between 0 and 160.)

You are now logged into the CLI.

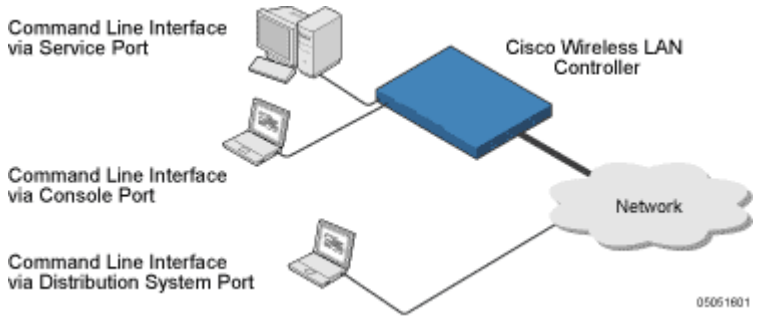
Using a Remote Ethernet Connection

You will need:

- A computer with access to the Cisco Wireless LAN Controller over the Ethernet network
- The IP Address of the Cisco Wireless LAN Controller
- You may use either a terminal emulation program or a DOS shell for the Telnet session.

> **Note:** By default, Telnet sessions are not allowed. You will need to enable Telnet sessions using your serial connection, and using the Cisco WLAN Solution CLI or Web User Interface.

Your computer may connect to the Cisco Wireless LAN Controller through the network using one of a variety of paths as shown in the following illustration.



1. Verify that your terminal emulation or DOS shell interface is configured with the following parameters:
   - Ethernet address
   - Port 23
2. In your terminal emulation interface, use the Cisco Wireless LAN Controller IP Address to Telnet to the Cisco Wireless LAN Controller command line interface. The CLI returns a login prompt.
3. Enter a valid login and password to enter the CLI. (The default login and password are **admin** and **admin**, respectively.)

   ```
   User:
   Password:
   ```

   Note that the login and password functions are case sensitive.
4. The CLI displays the root level system prompt:

   ```
   (system prompt)>
   ```

   The CLI allows a default of five users to be logged in at a time, but this number can be set from zero to five users.

   The system prompt can be any alphanumeric string, up to 31 characters, and can be changed. Because this is a user-defined variable, it is omitted from the rest of this documentation.

   The CLI automatically logs you out without saving any changes after a short period of inactivity. This automatic logout can be set from 0 (never log out), or from 1 to 160 minutes. (Use the CLI command **config serial timeout x,** where x is a number between 0 and 160.)

You are now logged into the CLI.

Logging Out of the CLI

- When you are done using the command line interface, navigate to the root level and enter **logout**. You will be prompted to save any changes you have made to the volatile RAM.

  Note: If you have recently cleared the volatile RAM configurations using *Clearing Configurations* and you save the configuration from the volatile RAM to the NVRAM, you will have to reconfigure the Cisco Wireless LAN Controller after reboot using the *Startup Wizard*.

CLI Tree Structure

The command line interface tree structure is organized around five levels:

Root Level

Level 2

Level 3

Level 4

Level 5

Following are some examples of CLI commands and their position in the tree structure.

?

help

clear

config

show

802.11a

config

advanced

802.11a

profile

noise

level

save

config

transfer

download

start

To view the latest CLI tree structure, log onto the CLI and use the *Navigating the CLI* commands.

Navigating the CLI

- You start at the root level.
- At the root level, type 'help' to see systemwide navigation commands.
- At all levels, type '?' to view the commands available from the current location.
- At all levels, type a command followed by '?' or ' ?' to view the parameters available for the command.
- Type any command name to move up to that level.
- Type 'exit' to go down a level.
- Enter <CTRL-Z> to return to the root level.
- From the root level, you can enter the whole command name. For instance, you can enter:

  >config prompt "Ent1"

  to change the system prompt to `Ent1 >`.
- To save your changes from active working RAM to non-volatile RAM (NVRAM) so they are retained upon reboot, use the **save config** command at the CLI root level.
- To reset the Cisco Wireless LAN Controller without logging out, use the **reset system** command at the root level of the CLI tree structure.
- When you are done using the CLI console, navigate to the root level and enter **logout**. You will be prompted to save any changes you have made from the active working RAM to the non-volatile RAM (NVRAM).

Viewing Network Status

Use the following Command Line Interface commands to view the status of the network controlled by a Cisco Wireless LAN Controller.

- Use the **show client** commands to display client information for each Cisco 1000 Series lightweight access point 802.11a and 802.11b/g RF coverage area, to display detailed information for a client connected through a particular Cisco 1000 Series lightweight access point, and display a summary of clients connected through the Cisco Wireless LAN Controller:

  >show client ap [802.11a/802.11b] <Cisco 1000 Series lightweight access point>
  >show client detail <MAC addr>
  >show client summary

  If you need to, use the **config client deauthenticate** command to deauthenticate an individual <MAC address>.
- Use the **show rogue-ap summary** and **show rogue-ap detail** commands to discover rogue access points on the subnet. If necessary, use the **config rogue-ap acknowledged, config rogue-ap alert,** and **config rogue-ap known** commands to mark the rogue access points in the Cisco Wireless LAN Controller database.
- In general, use the show commands to view the Cisco Wireless LAN Controller status.
- To test a link to a MAC address, use the **linktest** command at the CLI root level. Note that **linktest** does not work for IPSec links and does not work from Cisco 1000 Series lightweight access points.
- To ping an IP Address, use the **ping** command at the CLI root level.

Continue with *Using the Cisco WLAN Solution CLI*.

Configuring the Cisco Wireless LAN Controller

This section assumes that the Cisco Wireless LAN Controller is already installed, initially configured, and connected as described in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

Continue with the following sections to configure a Cisco Wireless LAN Controller using the command line interface (CLI):

- *Logging Into the CLI*
- *Navigating the CLI*
- *Collecting Cisco Wireless LAN Controller Parameters*
- *Configuring System Parameters*
- *Configuring Cisco Wireless LAN Controller Interfaces*
- *Configuring WLANs*
- *Configuring Mobility Groups*
- *Configuring RADIUS*
- *Configuring SNMP*
- *Configuring Other Ports and Parameters*
- *Transferring Files To and From a Cisco Wireless LAN Controller*
- *Updating the Operating System Software*
- *Using the Startup Wizard*
- *Adding SSL to the Web User Interface*
- *Adding SSL to the 802.11 Interface*
- *Saving Configurations*
- *Clearing Configurations*
- *Resetting the Cisco Wireless LAN Controller*
- *Erasing the Cisco Wireless LAN Controller Configuration*
- *Logging Out of the CLI*

Continue with *Using the Cisco WLAN Solution CLI*.

Collecting Cisco Wireless LAN Controller Parameters

Collect the high-level Cisco Wireless LAN Controller parameters:

System Parameters

- Supported protocols: 802.11a and/or 802.11b/g.
- New usernames and passwords (optional).

Network (Distribution System) Parameters

- Distribution System (network) port static IP Address, netmask, and optional default gateway IP Address from the network planner.
- Service port static IP Address and netmask from the network planner (optional).

- Distribution System physical port (1000BASE-T, 1000BASE-SX, or 10/100BASE-T).

  Note that 1000BASE-SX SFP modules provide a 1000 Mbps wired connection to a network through an 850nM (SX) fiber-optic link using an LC physical connector. 1000BASE-LX SFP modules provide a 1000 Mbps wired connection to a network through a 1300nM (LX/LH) fiber-optic link using an LC physical connector. 1000BASE-T SFP modules provide a 1000 Mbps wired connection to a network through a copper link using an RJ-45 physical connector.
- Distribution System port VLAN assignment (optional).
- Distribution System port Web and Secure Web mode settings, enabled or disabled.
- Distribution System port Spanning Tree Protocol: enabled/disabled, 802.1D/fast/off mode per port, path cost per port, priority per port, bridge priority, forward delay, hello time, maximum age.

WLAN Parameters

- WLAN Configuration: VLAN assignments, Layer 2 Security settings, Layer 3 Security settings, QoS assignments.

Mobility Parameters

- Mobility Settings: Mobility Group Name (optional).

RADIUS Parameters

- RADIUS Settings.

SNMP Parameters

- SNMP Settings.

Other Parameters

- Other Port and Parameter Settings: Service port, Radio Resource Management (RRM), Serial/CLI console port, 802.3x Flow Control, and System Logging.

Other Actions

- Assemble all files that may need uploading or downloading to the Cisco Wireless LAN Controller, including the latest OS code.

Continue with *Configuring System Parameters*.

Configuring System Parameters

The Cisco Wireless LAN Controller requires a few basic system parameters to communicate with other network devices. Perform the following to set these parameters:

Time and Date

- Use the **show time** command to view the Cisco Wireless LAN Controller time and date.
- If necessary, set the Cisco Wireless LAN Controller time and date by entering:

  >**config time MM/DD/YY HH:MM:SS**
- Use the **show time** command to verify that the Cisco Wireless LAN Controller has stored your input. Continue with the next parameter.

Country

The Cisco Wireless LAN Controller has been designed to be used in countries with different 802.11 country codes.

- Use the **show country** command to view the current Cisco Wireless LAN Controller country.
- If necessary, set the Cisco Wireless LAN Controller country code by entering:

  >config country <code>

  Where **<code>** =

  - US (United States of America), which allows 802.11b and 802.11g operation and 802.11a Low, Medium, and High bands.
  - USL (US Low), which allows 802.11b and 802.11g operation and 802.11a Low and Medium bands. (Used for legacy 802.11a interface cards that do not support 802.11a High band.)
  - AU (Australia), which allows 802.11a and 802.11b/g.
  - AT (Austria), which allows 802.11a and 802.11b/g.
  - BE (Belgium), which allows 802.11a and 802.11b/g.
  - CA (Canada), which allows 802.11b/g.
  - DK (Denmark), which allows 802.11a and 802.11b/g.
  - FI (Finland), which allows 802.11a and 802.11b/g.
  - FR (France), which allows 802.11a and 802.11b/g.
  - DE (Germany), which allows 802.11a and 802.11b/g.
  - GR (Greece), which allows 802.11b/g.
  - IE (Ireland), which allows 802.11a and 802.11b/g.
  - IN (India), which allows 802.11a and 802.11b.
  - IT (Italy), which allows 802.11a and 802.11b/g.
  - JP (Japan), which allows 802.11a and 802.11b/g.
  - KR (Republic of Korea), which allows 802.11a and 802.11b/g.
  - LU (Luxembourg), which allows 802.11a and 802.11b/g.
  - NL (Netherlands), which allows 802.11a and 802.11b/g.
  - PT (Portugal), which allows 802.11a and 802.11b/g.
  - ES (Spain), which allows 802.11a and 802.11b/g.
  - SE (Sweden), which allows 802.11a and 802.11b/g.
  - GB (United Kingdom), which allows 802.11a and 802.11b/g.

  Note: Refer to *Cisco WLAN Solution Supported Country Codes* for the latest country codes.

- Continue with the next parameter.

Supported 802.11a and 802.11b/g Protocols

The 802.11a and 802.11b/g protocols can be independently enabled or disabled.

- Use the **show sysinfo** command to view the 802.11a and 802.11b/g enabled/disabled status.
- Make sure these protocols are configured to agree with your wireless network plan and to comply with the Country regulations entered in the previous step using the following commands:

```
>config 802.11a enable network
>config 802.11a disable network
>config 802.11b enable network
>config 802.11b disable network
```

- Use the **show sysinfo** command to verify that the Cisco Wireless LAN Controller has stored your input. Continue with the next parameter.

Users and Passwords

After you have configured other system parameters, you are urged to change the username and password so unauthorized personnel cannot easily log into the Cisco Wireless LAN Controller.

- Use the **show mgmtuser** command to view the current management user names.
- Use the following commands to add new usernames and add or change passwords:

```
>config mgmtuser add <username> <password> [read-write/read-only]
>config mgmtuser password <username> <new password>
```

  where <username>, <password> and <new password> = Any ASCII character string, up to 24 characters, case sensitive, with no spaces.

- Use the **show mgmtuser** command to verify that your users have been accepted by the system. Continue with *Configuring Cisco Wireless LAN Controller Interfaces*.

Configuring Cisco Wireless LAN Controller Interfaces

As described in the *Distribution System Ports* section, the Cisco 2000 Series Wireless LAN Controller has up to four physical ports, the Cisco 4100 Series Wireless LAN Controller has two redundant physical ports, and the Cisco 4400 Series Wireless LAN Controller has one (4402) or two (4404) pairs of redundant physical ports. This means that the Cisco 4100 Series Wireless LAN Controller can physically connect to one subnet, and the Cisco 2000 Series Wireless LAN Controller and Cisco 4400 Series Wireless LAN Controllers can physically connect to multiple subnets.

Each of the physical ports can have multiple Interfaces applied to it:

- The *Management Interface* controls communications with network equipment for all physical ports in all cases.

  When the Cisco WLAN Solution is operated in Layer 2 Mode (see *Layer 2 and Layer 3 LWAPP Operation*), the Management Interface also controls communications between the Cisco Wireless LAN Controller and Cisco 1000 Series Lightweight Access Points.

  When the Cisco WLAN Solution is operated in Layer 3 Mode, the Management Interface no longer controls communications between the Cisco Wireless LAN Controller and Cisco 1000 Series lightweight access points.

- When the Cisco WLAN Solution is operated in Layer 3 Mode (see *Layer 2 and Layer 3 LWAPP Operation*), the *AP-Manager Interface* controls all communications between the Cisco Wireless LAN Controller and Cisco 1000 Series Lightweight Access Points.
- Each physical port can also have between one and 512 *Operator-Defined Interfaces*, also known as VLAN Interfaces, assigned to it. Each Operator-Defined Interface is individually

configured, and allows separate communication streams to exist on any or all of the physical port(s).

- The *Virtual Interface* controls Layer 3 Security and Mobility manager communications for Cisco Wireless LAN Controllers for all physical Ports. It also maintains the DNS Gateway hostname used by Layer 3 Security and Mobility managers to verify the source of certificates when Layer 3 Web Authorization is enabled.
- Note that the Cisco Wireless LAN Controller also has a *Service-Port Interface*, but that Interface can only be applied to the *Service Port*. This means that the Cisco 2000 Series Wireless LAN Controller, which has no *Service Port* also has no *Service-Port Interface*.

If you have not already done so, you must decide which physical port(s) you want to use, and then create and assign the following:

- *Verifying and Changing the Management Interface*
- *Creating and Assigning the AP-Manager Interface*
- *Creating, Assigning and Deleting Operator-Defined Interfaces*
- *Verifying and Changing the Virtual Interface*

Continue with the next section to configure the Distribution System IP Address.

Verifying and Changing the Management Interface

Normally, the static *Management Interface* parameters are defined when the Cisco Wireless LAN Controller is initially configured using the *Startup Wizard*. However, you may want to verify and/or change its parameters:

- Use the **show interface detailed management** command to view the current Management Interface settings. Note that the Management Interface uses the burned-in MAC address.
- To change any of the parameters, disable all WLANs.

  >**show wlan summary**

  >**config wlan disable <1-16>** (repeat for all enabled WLANs)

- And then use the following:

  >**config interface address management <IP addr> <IP netmask> [optional gateway]**

  >**config interface vlan management <VLAN ID|'0' for untagged>**

  >**config interface port management <Physical DS Port Number>**

  >**config interface dhcp management <IP addr of Primary DHCP server> <IP addr of optional Secondary DHCP server>**

  >**config interface acl management <Access Control List Name>** (Note)

  using the values collected from the network planner in *Collecting Cisco Wireless LAN Controller Parameters*.

  Note: If you are applying an Access Control List (ACL) to the Management Interface, you must first configure the ACL using the *Creating Access Control Lists* section.

Use the **show interface detailed management** command to verify that the Cisco Wireless LAN Controller has correctly stored your inputs. Note that this Interface cannot be deleted. Continue with the next section.

Creating and Assigning the AP-Manager Interface

The static *AP-Manager Interface* only exists when the Cisco WLAN Solution is operating in LWAPP Layer 3 Mode (see *Layer 2 and Layer 3 LWAPP Operation*).

- Use the **show interface summary** command to view the current Interfaces.

  If the Cisco WLAN Solution is operating in Layer 2 Mode, the `ap-manager` interface will not be listed. Either skip this section and continue with *Creating, Assigning and Deleting Operator-Defined Interfaces*, or go to *Converting a Cisco WLAN Solution from Layer 2 to Layer 3 Mode*.

- Use the **show interface detailed ap-manager** command to view the current AP-Manager Interface settings.

- To change any of the parameters, disable all WLANs.

  >show wlan summary

  >config wlan disable <1-16> (repeat for all enabled WLANs)

- And then use the following:

  >config interface address ap-manager <IP addr> <IP netmask> [optional gateway]

  >config interface vlan ap-manager <VLAN ID|'0' for untagged>

  >config interface port ap-manager <Physical DS Port Number>

  >config interface dhcp ap-manager <IP addr of Primary DHCP server> <IP addr of optional Secondary DHCP server>

  >config interface acl ap-manager <Access Control List Name> (Note)

  using the values collected from the network planner in *Collecting Cisco Wireless LAN Controller Parameters*.

  Note: If you are applying an Access Control List (ACL) to the Management Interface, you must first configure the ACL using the *Creating Access Control Lists* section.

Use the **show interface detailed ap-manager** command to verify that the Cisco Wireless LAN Controller has correctly stored your inputs. Note that this Interface cannot be deleted. Continue with the next section.

Creating, Assigning and Deleting Operator-Defined Interfaces

Each Cisco Wireless LAN Controller can support up to 512 dynamic *Operator-Defined Interfaces*. Each Operator-Defined Interface controls VLAN and other communications between Cisco Wireless LAN Controllers and all other network devices. Between one and 512 Operator-Defined Interfaces can be assigned to *Cisco WLAN Solution WLANs*, physical *Distribution System Ports*, the Layer 2 *Management Interface*, and the Layer 3 *AP-Manager Interface*.

Note: Operator-Defined Interfaces cannot be assigned to the dedicated Cisco 4100 Series Wireless LAN Controller or Cisco 4400 Series Wireless LAN Controller *Service Port*.

CAUTION: Operator-Defined Interface names cannot have spaces in them. If an Operator-Defined Interface name contains a space, you may not be able to edit its configuration using the *Command Line Interface*.

- Use the **show interface summary** command to view the current Operator-Defined Interfaces. They can be identified by the 'dynamic' Interface type.

- To view the details of an Operator-Defined Interface, use the **show interface detailed <operator-defined interface name>** command to view the current Operator-Defined Interface settings.
- To change any of the parameters or add another Operator-Defined Interface, disable all WLANs.

  >show wlan summary

  >config wlan disable <1-16> (repeat for all enabled WLANs)
- And then use the following:

  >config interface create <operator-defined interface name> <VLAN ID|'0' for untagged>

  >config interface address <operator-defined interface name> <IP addr> <IP netmask> [optional gateway]

  >config interface vlan <operator-defined interface name> <VLAN ID|'0' for untagged>

  >config interface port <operator-defined interface name> <Physical DS Port Number>

  >config interface dhcp <operator-defined interface name> <IP addr of Primary DHCP server> <IP addr of optional Secondary DHCP server>

  >config interface acl <operator-defined interface name> <Access Control List Name> (Note)

  using the values collected from the network planner in *Collecting Cisco Wireless LAN Controller Parameters*.

  Note: If you are applying an Access Control List (ACL) to the Operator-Defined Interface, you must first configure the ACL using the *Creating Access Control Lists* section.

Use the **show interface detailed <operator-defined interface name>** and **show interface summary** commands to verify that the Cisco Wireless LAN Controller has correctly stored your inputs.

- To delete an Operator-Defined Interface, use the following command:

  >config interface delete <operator-defined interface name>

Continue with the next section.

Verifying and Changing the Virtual Interface

The static *Virtual Interface* controls Layer 3 Security and Mobility manager communications for a Cisco Wireless LAN Controller, and it maintains the DNS Gateway hostname used by Layer 3 Security and Mobility managers to verify the source of certificates when Layer 3 Web Authorization is enabled.

- Use the **show interface detailed virtual** command to view the current AP-Manager Interface settings.
- To change any of the parameters, disable all WLANs.

  >show wlan summary

  >config wlan disable <1-16> (repeat for all enabled WLANs)

- And then use the following:

  >**config interface address virtual <IP addr>** where **<IP addr>** is any fictitious, unassigned, unused Gateway IP Address.

  >**config interface hostname virtual <DNS Host Name>**

  using the values collected from the network planner in *Collecting Cisco Wireless LAN Controller Parameters*.

  Note: If you change any of the Virtual Interface settings, reset the Cisco Wireless LAN Controller and save the configuration as described in *Resetting the Cisco Wireless LAN Controller*.

Use the **show interface detailed virtual** command to verify that the Cisco Wireless LAN Controller has correctly stored your inputs. Note that this Interface cannot be deleted. Continue with the next section.

Enabling Web and Secure Web Modes

- Use the following commands to enable (default) or disable the Distribution System port as a Web port and/or a Secure Web port:

  >**config network webmode [enable/disable]**

  >**config network secureweb [enable/disable]**

Use the **show network** command to verify that your inputs were accepted. Continue with the next parameter.

Configuring Spanning Tree Protocol

Spanning Tree Protocol is initially disabled for the Distribution System (network) ports. You can enable STP on the Cisco Wireless LAN Controller for all physical ports using the following commands. If you are not configuring Spanning Tree Protocol at this time, skip this section.

- Use the **show spanningtree port** and **show spanningtree switch** commands to view the current STP status.
- Disable STP on the Cisco Wireless LAN Controller by entering:

  >**config spanningtree switch mode disable**

  This causes the Cisco Wireless LAN Controller to disable support for STP on all ports.

  Note: STP must be disabled before the STP parameters can be changed; leave STP disabled until you have finished configuring all associated parameters.

- Configure the STP port administrative mode on the desired ports using one of the following commands:

  >**config spanningtree port mode 802.1d [<port number>/all] (default)**
  >**config spanningtree port mode fast [<port number>/all]**
  >**config spanningtree port mode off <[<port number>/all]**

  where <port number> = 1 through 13 or 1 through 25, and all = all ports.

- Configure STP port path cost on the STP ports using one of the following commands:

  >**config spanningtree port pathcost <1-65535> [<port number>/all]**
  >**config spanningtree port mode pathcost auto [<port number>/all] (default)**

  where <1-65535> = Path cost supplied by the network planner, and auto = allow the STP algorithm to automatically assign the path cost (default).

- Configure port priority on the STP ports using the following command:

  >config spanningtree port priority <0-255> <port number>

  where <0-255> = STP priority for this port (default priority = 128).

- If required, configure the Cisco Wireless LAN Controller STP bridge priority using the following command:

  >config spanningtree switch bridgepriority <0-65535>

  where <0-65535> = STP bridge priority for this Cisco Wireless LAN Controller (default priority = 32768).

- If required, configure the Cisco Wireless LAN Controller STP forward delay using the following command:

  >config spanningtree switch forwarddelay <4-30>

  where <4-30> seconds = STP forward delay for this Cisco Wireless LAN Controller (default forward delay = 15 seconds).

- If required, configure the Cisco Wireless LAN Controller STP hello time using the following command:

  >config spanningtree switch hellotime <1-10>

  where <1-10> seconds = STP hello time for this Cisco Wireless LAN Controller (default hello time = 2 seconds).

- If required, configure the Cisco Wireless LAN Controller STP maximum age using the following command:

  >config spanningtree switch maxage <6-40>

  where <6-40> seconds = STP maximum age for this Cisco Wireless LAN Controller (default = 20 seconds).

- After all the ports have been configured for the desired STP settings, enter the following:

  >config spanningtree switch mode enable

  This procedure allows the Cisco Wireless LAN Controller to most efficiently set up STP, detect logical network loops, place redundant ports on standby, and build a network with the most efficient pathways.

You have configured STP for the Cisco Wireless LAN Controller. Verify that your settings are stored in memory using the **show spanningtree port** and **show spanningtree switch** commands. Continue with *Configuring WLANs*.

Creating Access Control Lists

When you wish to create Access Control Lists, Cisco WLAN Solution strongly recommends that you use the Web User Interface. Refer to the Access Control Lists page in the Web User Interface Online Help document.

Configuring WLANs

Cisco Wireless LAN Controllers can control up to 16 Cisco WLAN Solution Wireless LANs as described in *Cisco WLAN Solution WLANs*.

If you are not configuring WLANs at this time, skip this section and continue with *Configuring Mobility Groups*.

WLANs

- Use the **show wlan summary** command to display the current WLANs and whether they are enabled or disabled. Note that each Cisco WLAN Solution WLAN is assigned a WLAN ID from 1 to 16.
- If you are creating WLANs, use the following commands:

  >config wlan create <wlan id> <wlan name>

  where <wlan id> = 1 through 16, <wlan name> = SSID (up to 31 alphanumeric characters).

  Note: When WLAN 1 is created in the *Startup Wizard*, it is created in enabled mode; disable it until you have finished configuring it. When you create a new WLAN using the **config wlan create** command, it is created in disabled mode; leave it disabled until you have finished configuring it.

- If you are modifying enabled WLANs, make sure they are disabled using the **show wlan summary** command. If they are not disabled, use the following to disable them:

  >config wlan disable <wlan id>

  where <wlan id> = 1 through 16. Leave the WLANs in disabled mode until you have finished configuring them.
- If you are deleting WLANs, use the following command:

  >config wlan delete <wlan id>

  where <wlan id> = 1 through 16.

DHCP Server

Each WLAN can be assigned to a DHCP server. Any or all WLANs can be assigned to the same DHCP server, and each WLAN can be assigned to a different DHCP servers. This assignment is mandatory for WLANs that allow *Management over Wireless*, as described in *External DHCP Servers*.

- Use the **show wlan** command to verify whether you have a DHCP Server assigned to the WLAN.
- If necessary, use the following command:

  >config wlan dhcp_server <WLAN id> <IP Address>

  where <WLAN id> = 1 through 16, <IP Address> = DHCP Server IP Address,
- Use the **show wlan** command to verify that you have a DHCP Server assigned to the WLAN.

MAC Filtering

Whenever you are going to use MAC filtering for Cisco Wireless LAN Controller or RADIUS authorization, you need to enable it at the WLAN level first. If you plan to use local MAC address filtering for any WLAN, use the following commands to configure the MAC Address Filter List:

- Use the **show wlan** command to verify whether you have MAC filtering enabled or disabled for each WLAN.

- If necessary, use the following command:

  >config wlan mac-filtering enable <WLAN id>

  where <WLAN id> = 1 through 16.

- Use the **show wlan** command to verify that you have MAC filtering enabled or disabled for each WLAN.

Local MAC Filter

Cisco Wireless LAN Controllers have built-in MAC filtering capability, similar to that provided by a RADIUS authorization server.

- Use the **show macfilter** command to verify that you have MAC addresses assigned to WLANs.
- If required, use the following commands to assign local MAC addresses to WLANs, and to configure a WLAN to filter a local client:

  >config macfilter add <MAC addr> <WLAN id>

  >config macfilter wlan-id <MAC addr> <WLAN id>

  where <MAC addr> = client MAC address and <WLAN id> = 1 through 16.

- Use the **show macfilter** command to verify that you have MAC addresses assigned to WLANs.

Disable Timeout

Each WLAN can have a variable timeout for excluded, or disabled clients. Clients who fail to authenticate three times when attempting to associate are automatically excluded, or disabled, from further association attempts. After the exclusion timeout period expires, the client is allowed to retry authentication until it associates or fails authentication and is excluded again.

- Use the **show wlan** command to check the current WLAN Disable (Excluded) Timeout.
- If necessary, use the following command to change the Disable (Excluded) Timeout:

  >config wlan blacklist <WLAN id> <timeout>

  where <WLAN id> = 1 through 16, and <timeout> = 1 to 65535 seconds, 0 to add to the Exclusion List (formerly blacklist) permanently until the operator manually removes the exclusion.

- Use the **show wlan** command to verify the current WLAN Disable (Excluded) Timeout.

VLANs

> **Note:** WLANs are created in disabled mode; leave them disabled until you have finished configuring them.

- Use the **show wlan** command to verify VLAN assignment status.
- To assign a VLAN to a WLAN, use the following command:

  >config wlan vlan <wlan id> [<default>/<untagged>/<VLAN ID> <IP Address> <VLAN Netmask> <VLAN Gateway>]

  where <WLAN id> = 1 through 16, <default> = use the VLAN configured on the network port, <untagged> = use VLAN 0, <VLAN id> = 1 through 4095, <IP Address> = the VLAN IP Address on the Cisco Wireless LAN Controller, <VLAN Netmask> = VLAN local IP netmask, and <VLAN Gateway> = VLAN local IP gateway.

- To remove a VLAN assignment from a WLAN, use the following command:

  >config wlan vlan <WLAN id> untagged

  where <WLAN id> = 1 through 16.

- Use the **show wlan <wlan id>** command to verify that you have correctly assigned a VLAN to the WLAN.

Layer 2 Security

> **Note:** WLANs are created in disabled mode; leave them disabled until you have finished configuring them.

Dynamic 802.1X Keys and Authorization

Cisco Wireless LAN Controllers can control 802.1X dynamic keys using EAP (extensible authentication protocol) across Cisco 1000 Series lightweight access points, and supports 802.1X dynamic key settings for the Cisco 1000 Series lightweight access point WLAN(s).

- Use the **show wlan <wlan id>** command to check the security settings of each WLAN. The default for new WLANs is 802.1X with dynamic keys enabled. If you want to keep a robust Layer 2 policy, leave 802.1X on.
- If you want to change the 802.1X configuration, use the following commands:

  >config wlan security 802.1X [enable/disable] <wlan id>

  where <WLAN id> = 1 through 16.
- If you want to change the 802.1X encryption for a Cisco 1000 Series lightweight access point WLAN, use the following command:

  >config wlan security 802.1X encryption <wlan id> [40/104/128]

  where <WLAN id> = 1 through 16, and [40/104/128] = 40/64, 104/128 (default) or 128/152 encryption bits (default = 104/128).

WEP Keys

Cisco Wireless LAN Controllers can control WEP keys across Cisco 1000 Series lightweight access points.

- Use the **show wlan <wlan id>** command to check the security settings of each WLAN. The default is 802.1X with dynamic keys enabled.
- If you want to configure the less-robust WEP (Wired Equivalent Privacy) authorization policy, turn 802.1X off:

  >config wlan security 802.1X disable <wlan id>

  where <wlan id> = 1 through 16.
- Then configure 40/64, 104/128 or 128/152 bit WEP keys on 802.1X disabled WLANs using the following command:

  >config wlan security static-wep-key encryption <wlan id> [40/104/128] [hex/ascii] <key> <key-index>

  where:

  - <wlan id> = 1 through 16;
  - [hex/ascii] = key character format;
  - <key> = Ten hexadecimal digits (any combination of 0-9, a-f, or A-F), or five printable ASCII characters for 40-bit/64-bit WEP keys, 26 hexadecimal or 13 ASCII characters

for 104-bit/128-bit keys, or 32 hexadecimal or 16 ASCII characters for 128-bit/152-bit keys; and

- <key-index> = 1 through 4.

Note: One unique WEP Key Index can be applied to each WLAN. Because there are only four <key-index> numbers, only four WLANs can be configured for Static WEP Layer 2 encryption. Also note that some legacy clients can only access Key Index 1 through 3 but cannot access Key Index 4.

Dynamic WPA Keys and Encryption

Cisco Wireless LAN Controllers can only control WPA (Wi-Fi Protected Access) authorization policy across Cisco 1000 Series lightweight access points.

- Use the **show wlan <wlan id>** command to check the security settings of each WLAN. The default is 802.1X with dynamic keys enabled.
- If you want to configure the more-robust WPA authorization policy, turn 802.1X off:

  >config wlan security 802.1X disable <wlan id>

  where <wlan id> = 1 through 16.
- Then configure authorization and dynamic key exchange on 802.1X disabled WLANs using the following commands:

  >config wlan security wpa enable <wlan id>

  >config wlan security wpa encryption aes-ocb <wlan id>

  >config wlan security wpa encryption tkip <wlan id>

  >config wlan security wpa encryption wep <wlan id> [40/104/128]

  where <wlan id> = 1 through 16, and [40/104/128] = 40/64, 104/128, or 128/156 encryption bits (default = 104).
- Use the **show wlan** command to verify that you have WPA enabled.

Layer 3 Security

Note: WLANs are created in disabled mode; leave them disabled until you have finished configuring them.

Note: Using Layer 3 security requires that the Cisco 4100 Series Wireless LAN Controller be equipped with an VPN/Enhanced Security Module (Crypto Module). The module plugs into the rear of the Cisco 4100 Series Wireless LAN Controller, and provides the extra processing power needed for processor-intensive security algorithms.

IPSec

IPSec (Internet Protocol Security) supports many Layer 3 security protocols.

- Use the **show wlan** command to show the current IPSec configuration.
- Use the following command to enable IPSec on a WLAN:

  >config wlan security ipsec [enable/disable] <WLAN id>

  where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have IPSec enabled.

IPSec Authentication

IPSec uses hmac-sha-1 authentication as the default for encrypting WLAN data, but can also use hmac-md5, or no authentication.

- Use the **show wlan** command to view the current IPSec authentication protocol.
- Use the following command to configure the IPSec IP authentication:

  >config wlan security ipsec authentication [hmac-md5/hmac-sha-1/none] <WLAN id>

  where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have correctly set the IPSec authentication.

IPSec EncryptionI

IPSec uses 3DES encryption as the default for encrypting WLAN data, but can also use AES, DES, or no encryption.

- Use the **show wlan** command to view the current IPSec encryption.
- Use the following command to configure the IPSec encryption:

  >config wlan security ipsec encryption [3des/aes/des/none] <WLAN id>

  where aes= AES-CBC, and where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have correctly set the IPSec encryption.

IKE Authentication

IPSec IKE (Internet Key Exchange) uses pre-shared key exchanges, x.509 (RSA Signatures) certificates, and XAuth-psk for authentication.

- Use the **show wlan** command to see if IPSec IKE is enabled.
- Use the following commands to configure IKE authentication on a WLAN with IPSec enabled:

  >config wlan security ipsec ike authentication certificates <wlan id>

  >config wlan security ipsec ike authentication xauth-psk <wlan id> <key>

  >config wlan security ipsec ike authentication pre-shared-key <wlan id> <key>

  where <wlan id> = 1 through 16, certificates = RSA signatures, xauth-psk = XAuth pre-shared key, and <key> = Preshared Key (Eight to 255 ASCII characters, case sensitive).
- Use the **show wlan** command to verify that you have IPSec IKE enabled.

IKE Diffie-Hellman Group

IPSec IKE uses Diffie-Hellman groups to block easily-decrypted keys.

- Use the **show wlan** command to verify whether or not the Cisco Wireless LAN Controller has IPSec IKE DH Groups properly set.
- Use the following command to configure the IKE Diffie-Hellman group on a WLAN with IPSec enabled:

  >config wlan security ipsec ike DH-Group <WLAN id> <group-id>

  where <WLAN id> = 1 through 16; <group-id> = group-1, group-2 (default), or group-5.
- Use the **show wlan** command to verify that the Cisco Wireless LAN Controller has IPSec IKE DH Groups properly set.

IKE Phase 1 Aggressive and Main Modes

IPSec IKE uses the Phase 1 Aggressive (faster) or Main (more secure) mode to set up encryption between clients and the Cisco Wireless LAN Controller.

- Use the **show wlan** command to see if the Cisco Wireless LAN Controller has IPSec IKE Aggressive mode enabled.
- If necessary, use the following command to configure the IKE Aggressive or Main mode on a WLAN with IPSec enabled:

  >**config wlan security ipsec ike phase1 [aggressive/main] <WLAN id>**

  where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have IPSec IKE Aggressive or Main mode enabled.

IKE Lifetime Timeout

IPSec IKE uses its timeout to limit the time that an IKE key is active.

- Use the **show wlan** command to see the current IPSec IKE lifetime timeout.
- Use the following command to configure the IKE lifetime on a WLAN with IPSec enabled:

  >**config wlan security ipsec ike lifetime <WLAN id> <seconds>**

  where <WLAN id> = 1 through 16, and <seconds> = 1800 through 345600 seconds (default = 28800 seconds).
- Use the **show wlan** command to verify that you have IPSec IKE timeout properly set.

IPSec Passthrough

IPSec IKE uses IPSec Passthrough to allow IPSec-capable clients to communicate directly with other IPSec equipment. IPSec Passthrough is also known as VPN Passthrough.

- Use the **show wlan** command to see the current IPSec passthrough status.
- Use the following command to configure IKE passthrough for a WLAN:

  >**config wlan security passthru [enable/disable] <WLAN id> [gateway]**

  where <WLAN id> = 1 through 16, and [gateway] = IP Address of IPSec (VPN) passthrough gateway.
- Use the **show wlan** command to verify that you have IPSec passthrough properly set.

Web Based Authentication

WLANs can use Web Authentication if IPSec is not enabled on the Cisco Wireless LAN Controller. Web Authentication is simple to set up and use, and can be used with SSL to improve the overall security of the wireless LAN.

- Use the **show wlan** command to see the current Web Authentication status.
- Use the following command to configure Web Authentication for a WLAN:

  >**config wlan security web [enable/disable] <WLAN id>**

  where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have Web Authentication properly set.

Local Netuser

> **Note:** WLANs are created in disabled mode; leave them disabled until you have finished configuring them.

Cisco Wireless LAN Controllers have built-in network client authentication capability, similar to that provided by a RADIUS authentication server.

- Use the **show netuser** command to see if the Cisco Wireless LAN Controller has network client names assigned to WLANs.
- If required, use the following commands to assign a network client name and password to a particular WLAN, delete a network client, assign a network client password, and assign a network client name to a WLAN without a password:

  >config netuser add <username> <password> <WLAN id>

  >config netuser delete <username>

  >config netuser password <username> <password>

  >config netuser wlan-id <username> <WLAN id>

  where <WLAN id> = 1 through 16.
- Use the **show netuser** command to verify that you have net user names assigned to WLANs.

Quality of Service

> **Note:** WLANs are created in disabled mode; leave them disabled until you have finished configuring them.

Cisco WLAN Solution WLANs support four levels of QoS: Platinum/Voice, Gold/Video, Silver/Best Effort (default) and Bronze/Background. Network administrators can choose to assign the voice traffic WLAN to use Platinum QoS, assign the low-bandwidth WLAN to use Bronze QoS, and assign all other traffic between the remaining QoS levels.

- Use the **show wlan** command to verify that you have QoS properly set for each WLAN.
- If required, use the following command to configure QoS for each WLAN:

  >config wlan qos <WLAN id> [bronze/silver/gold/platinum]

  where <WLAN id> = 1 through 16.
- Use the **show wlan** command to verify that you have QoS properly set for each WLAN.

Activating WLANs

After you have completely configured your WLAN settings, activate the WLAN using the **config wlan enable** command.

Continue with *Configuring Mobility Groups*.

Configuring Mobility Groups

All Cisco Wireless LAN Controllers that can communicate with each other through their Distribution System (network) ports can automatically discover each other and form themselves into groups. After they are grouped, the Cisco WLAN Solution Radio Resource Management (RRM) function maximizes its inter-Cisco Wireless LAN Controller processing efficiency and mobility processing, described in the *Client Roaming* section.

Cisco Wireless LAN Controller group discovery is automatically enabled when two or more members are assigned to the same mobility group name. Note that this feature must be enabled on each Cisco Wireless LAN Controller to be included in the discovery process.

- Use the **show mobility summary** command to verify the current Cisco Wireless LAN Controller mobility settings.
- To give a Mobility Group a name, use the following command:

  >config mobility group name <group_name>

  where <group_name> = Any ASCII character string, up to 31 characters, case sensitive, with no spaces.
- To manually add or delete members to a mobility group, use the following commands:

  >config mobility group member add <mac-address> <IP addr>
  >config mobility group member delete <mac-address> <IP addr>

  where <mac-address> is the MAC address and where <IP addr> is the IP Address of the group member to be added or deleted.

Use the **show mobility summary** commands to verify that the Cisco Wireless LAN Controller mobility is set up correctly. Continue with *Configuring RADIUS*.

Configuring RADIUS

- When your Cisco WLAN Solution is to use an external RADIUS server for accounting and/or authentication, set up the links using the following commands. If you are not configuring RADIUS links at this time, continue with *Configuring SNMP*.

  >config radius acct <address>
  >config radius acct <port>
  >config radius acct <secret>
  >config radius acct [disable/enable]

  >config radius auth <address>
  >config radius auth <port>
  >config radius auth <secret>
  >config radius auth [disable/enable]

  where <address> = server name or IP Address, <port> = UDP port number, <secret> = the RADIUS server's secret.

When you have completed these configurations, use the **show radius acct statistics, show radius auth statistics** and **show radius summary** commands to verify that the RADIUS links are correctly configured. Continue with *Configuring SNMP*.

Configuring SNMP

- When your Cisco WLAN Solution is to send SNMP protocol to the Cisco Wireless Control System or any other SNMP manager, configure the SNMP environment using the following commands. If you are not configuring SNMP traps at this time, continue with *Configuring Other Ports and Parameters*.

  ```
  >config snmp community accessmode <ro/rw> <name>
  >config snmp community create <name>
  >config snmp community delete <name>
  >config snmp community ipaddr <ipaddr> <ipmask> <name>
  >config snmp community mode [enable/disable]

  >config snmp trapreceiver create <name> <ipaddr>
  >config snmp trapreceiver delete <name>
  >config snmp trapreceiver ipaddr <old ipaddr> <name> <new ipaddr>
  >config snmp trapreceiver mode [enable/disable]

  >config snmp syscontact <syscontact name>

  >config snmp syslocation <syslocation name>
  ```

  where <ro/rw> = read only/read-write, <name> = SNMP community name, <ipaddr> = SNMP community IP Address, <ipmask> = SNMP community IP mask, <old ipaddr> = old SNMP IP Address, <new ipaddr> = new SNMP IP Address, <syscontact name> = system contact, up to 31 alphanumeric characters, <syslocation name> = system location, up to 31 alphanumeric characters.

When you have completed these configurations, use the **show snmpcommunity** and **show snmptrap** commands to verify that the SNMP traps and communities are correctly configured.

Also use the **show trapflags** command to see the enabled and disabled trapflags. If necessary, use the **config trapflags** commands to enable and disable any or all trapflags.

Continue with *Configuring Other Ports and Parameters*.

Configuring Other Ports and Parameters

Use the following sections to configure the remaining Cisco Wireless LAN Controller ports and parameters:

- *Service Port*
- *Radio Resource Management (RRM)*
- *Serial (CLI Console) Port*
- *802.3x Flow Control*
- *System Logging*

Service Port

- The Service port on Cisco 4100 Series Wireless LAN Controllers and Cisco 4400 Series Wireless LAN Controllers can be configured with a separate IP Address, subnet mask, and IP assignment protocol from the Distribution System (network) port. To display and configure the Service port parameters, use the following commands:

  ```
  >show serviceport
  >config serviceport params
  >config serviceport protocol
  ```

Radio Resource Management (RRM)

- The Operating System Radio Resource Management (RRM) function automatically recognizes Cisco 1000 Series lightweight access points as they appear in the air space, and when they are part of the same *Cisco WLAN Solution Mobility Group*, automatically configures them for optimal operation in their respective frequency bands.

  Typically, you will not need to manually configure anything after enabling and/or disabling the 802.11a and 802.11b/g networks as described in *Configuring System Parameters*. However, you may want to fine-tune the network operation using the **config 802.11a, config 802.11b, config advanced 802.11a, config advanced 802.11b, config cell,** and **config load balancing** command sets.

Serial (CLI Console) Port

- The Cisco Wireless LAN Controller serial port is set for a 9600 baud rate and a short timeout. If you would like to change either of these values, use the **config serial baudrate** and **config serial timeout** commands to make your changes. Note that if you enter **config serial timeout 0,** serial sessions never time out.

802.3x Flow Control

- 802.3x Flow Control is normally disabled on the Cisco Wireless LAN Controller. If you would like to change either of these settings, use the **config switchconfig flowcontrol** command.

System Logging

- Cisco Wireless LAN Controllers are shipped with the syslog function disabled. Use the **show syslog** command to view the current syslog status, and if required, use the **config syslog** command to send a Cisco Wireless LAN Controller log to a remote IP Address or hostname.

You have configured the basic parameters for a Cisco Wireless LAN Controller. Continue with *Using the Cisco WLAN Solution CLI*.

Adding SSL to the Web User Interface

When you plan to secure the Cisco Wireless LAN Controller HTTP: Web User Interface using the https: (HTTP + SSL) protocol, note that the Operating System automatically generates its own local Web Administration SSL certificate and automatically applies it to the Web User Interface. Verify whether or not the locally-generated Web Administration certificate is already loaded:

```
>show certificate summary
Web Administration Certificate..... Locally Generated
Web Authentication Certificate..... Locally Generated
Certificate compatibility mode:..... off
```

Continue with either of the following two sections:

- *Locally-Generated Certificate* or an
- *Externally-Generated Certificate*.

Locally-Generated Certificate

Should you desire to have the Operating System generate a new Web Administration SSL certificate, complete the following:

- In the CLI, enter:

  ```
  >config certificate generate webadmin
  ```

  Wait a few seconds, and the Cisco Wireless LAN Controller returns:

  ```
  Web Administration certificate has been generated
  ```

- Verify that the Web Administration certificate is properly loaded:

  ```
  >show certificate summary
  Web Administration Certificate..... Locally Generated
  Web Authentication Certificate..... Locally Generated
  Certificate compatibility mode:..... off
  ```

- Enable Secure Web mode:

  ```
  >config network secureweb enable
  ```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

  ```
  >save config
  Are you sure you want to save? (y/n) y
  Configuration Saved!
  ```

- Reboot the Cisco Wireless LAN Controller:

  ```
  >reset system
  Are you sure you would like to reset the system? (y/n) y
  System will now restart!
  ```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that operators using the Web User Interface know that they may securely log into the Cisco Wireless LAN Controller using “https://<Cisco Wireless LAN Controller_IPaddress>.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Externally-Generated Certificate

Should you desire to use your own Web Administration SSL certificate, complete the following:

- Make sure you have a TFTP server available for the certificate download:
  - If you are downloading through the Service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - If you are downloading through the DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.

  Note: The TFTP server cannot run on the same computer as the Cisco Wireless Control System, because the Cisco WCS and the TFTP server use the same communication port.

  CAUTION: Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

- Buy or create your own Web Administration SSL key and certificate. If not already done, use a password, <private_key_password>, to encrypt the key and certificate in a .PEM encoded file. The PEM-encoded file is called a Web Administration Certificate file (<webadmincert_name>.pem).
- Move the <webadmincert_name>.pem file to the default directory on your TFTP server.
- Refer to the *Using the Cisco WLAN Solution CLI* section to connect and use the CLI.
- In the CLI, use the **transfer download start** command, and answer 'n' to the prompt, to view the current download settings:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Admin Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename.............................

Are you sure you want to start? (y/n) n

Transfer Canceled
```

- To change the download settings, use the following:

```
>transfer download mode tftp

>transfer download datatype webauthcert

>transfer download serverip <TFTP server IP address>

>transfer download path <absolute TFTP server path to the update file>

>transfer download filename <webadmincert_name>.pem
```

  Note: Some TFTP servers require only a forward slash "/" as the **<TFTP server IP address>,** and the TFTP server automatically determines the path to the correct directory.

- Enter the password for the .PEM file, so Operating System can decrypt the Web Administration SSL key and certificate:

```
>transfer download certpassword <private_key_password>
>Setting password to <private_key_password>
```

- In the CLI, use the **transfer download start** command to view the updated settings, and answer 'y' to the prompt to confirm the current download settings and start the certificate and key download:

```
>transfer download start

Mode..................................... TFTP
Data Type................................ Site Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename............................ <webadmincert_name>

Are you sure you want to start? (y/n) y

TFTP Webadmin cert transfer starting.

Certificate installed.
  Please restart the switch (reset system) to use the new certificate.
```

- Verify that the Web Administration certificate is properly loaded:

```
>show certificate summary
Web Administration Certificate................. Locally Generated
Web Authentication Certificate................. Locally Generated
Certificate compatibility mode:................ off
```

- Enable Secure Web mode:

```
>config network secureweb enable
```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

```
>save config

Are you sure you want to save? (y/n) y

Configuration Saved!
```

- Reboot the Cisco Wireless LAN Controller:

```
>reset system

Are you sure you would like to reset the system? (y/n) y

System will now restart!
```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that operators using the Web User Interface know that they may securely log into the Cisco Wireless LAN Controller using "https://<Cisco Wireless LAN Controller_IPaddress>.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Transferring Files To and From a Cisco Wireless LAN Controller

Cisco Wireless LAN Controllers have built-in utilities for uploading and downloading Operating System software, certificate and configuration files. Refer to the following for additional information.

> **CAUTION:** Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

- Use the CLI **transfer** commands to perform these actions:

```
>transfer download datatype
>transfer download filename
>transfer download mode
>transfer download path
>transfer download serverip
>transfer download start

>transfer upload datatype
>transfer upload filename
>transfer upload mode
>transfer upload path
>transfer upload serverip
>transfer upload start
```

Continue with *Using the Cisco WLAN Solution CLI*.

Updating the Operating System Software

When you plan to update the Cisco Wireless LAN Controller (and Cisco 1000 Series lightweight access point) Operating System software, complete the following.

> **Note:** You can also start the Operating System software update using the Web User Interface or *Management over Wireless*. However, in these cases, you will lose your connection to the Cisco Wireless LAN Controller some time during the update process. For this reason, Cisco strongly recommends that you use a direct CLI console port connection to update the Operating System software.

> **Note:** On the Cisco 2000 Series Wireless LAN Controller, the TFTP server MUST be on the same subnet because this Cisco Wireless LAN Controller does not have a service port.

- Make sure you have a TFTP server available for the Operating System software download.
  - If you are downloading through the Service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - If you are downloading through the DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.

> **Note:** The TFTP server cannot run on the same computer as the Cisco Wireless Control System, because the Cisco WCS and the TFTP server use the same communication port.

- Download the desired Operating System software update file from the Cisco website to the default directory on your TFTP server.
  - The Operating System code update file is named AS_2000_3_0_x_x for Cisco 2000 Series Wireless LAN Controllers, or AS_4100_3_0_x_x for Cisco 4100 Series Wireless LAN Controllers, or AS_4400_3_0_x_x for Cisco 4400 Series Wireless LAN Controllers. Note that the Cisco Wireless LAN Controller can be updated or reverted between the 2.2 and 3.0 OS releases.
- Refer to the *Using the Cisco WLAN Solution CLI* section to connect and use the CLI.
- In the CLI, use the **ping <IP Address>** command to ensure the Cisco Wireless LAN Controller can contact the TFTP server.
- In the CLI, use the **transfer download start** command, and answer 'n' to the prompt, to view the current download settings:

```
>transfer download start
Mode............................................ TFTP
Data Type....................................... Code
TFTP Server IP.................................. xxx.xxx.xxx.xxx
TFTP Path....................................... <directory path>
TFTP Filename................................... AS_2000_3_0_x_x.aes --OR--
                                                 AS_4100_3_0_x_x.aes --OR--
                                                 AS_4400_3_0_x_x.aes


Are you sure you want to start? (y/n) n
Transfer Canceled
>
```

- To change the download settings, use the following:

```
>transfer download mode tftp
>transfer download datatype code
>transfer download serverip <TFTP server IP address>
>transfer download filename AS_2000_<release_number>.aes or
AS_4100_<release_number>.aes or AS_4400_<release_number>.aes
>transfer download path <absolute TFTP server path to the update file>
```

  Note: All TFTP servers require the full pathname. For example in Windows, **C:\TFTP-Root**. (In UNIX forward slashes "/" are required.)

- In the CLI, use the **transfer download start** command to view the updated settings, and answer 'y' to the prompt to confirm the current download settings and start the Operating System code download:

```
>transfer download start
Mode............................................ TFTP
Data Type....................................... Code
TFTP Server IP.................................. xxx.xxx.xxx.xxx
TFTP Path....................................... <directory path>
TFTP Filename................................... AS_2000_3_0_x_x.aes --OR--
                                                 AS_4100_3_0_x_x.aes --OR--
                                                 AS_4400_3_0_x_x.aes


Are you sure you want to start? (y/n) y
TFTP Code transfer starting.
```

```
TFTP receive complete... extracting components.
Writing new bootloader to flash.
Making backup copy of RTOS.
Writing new RTOS to flash.
Making backup copy of Code.
Writing new Code to flash.
TFTP File transfer operation completed successfully.
  Please restart the switch (reset system) for update to complete.
```

- The Cisco Wireless LAN Controller now has the code update in active volatile RAM, but you must save the code update to non-volatile NVRAM and reboot the Cisco Wireless LAN Controller:

  ```
  >reset system
  The system has unsaved changes.
  Would you like to save them now? (y/n) y
  ```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Performing Power On Self Test step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

  ▶ **Note:** If you wish to run a previous release of the Cisco Wireless LAN Controller code, follow the instructions in the Connecting and Using the CLI Console step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Using the Startup Wizard

When a Cisco Wireless LAN Controller is powered up with a new factory Operating System software load or after being reset to factory defaults, the bootup script runs the Startup Wizard, which prompts the installer for initial Cisco Wireless LAN Controller configuration.

▶ **Note:** To reset the Cisco Wireless LAN Controller to factory defaults and rerun the Startup Wizard, refer to *Erasing the Cisco Wireless LAN Controller Configuration*.

Use the Startup Wizard to do the following:

- Enter the System (Cisco Wireless LAN Controller) Name, up to 32 printable ASCII characters.
- Enter the Administrative username and password, each up to 24 printable ASCII characters. The default Administrative User login and password are **admin** and **admin**, respectively.

  ▶ **Note:** The *Service-Port Interface* and *Management Interface* must be on different subnets.

- Enter the *Service-Port Interface* IP configuration protocol (**none**, or **DHCP**). If you do not want to use the Service port or if you want to assign a static IP Address to the Service port, enter **none**.

  If you entered **none**, enter *Service-Port Interface* IP Address and netmask on the next two lines. If you do not want to use the Service port, enter **0.0.0.0** for the IP Address and netmask.

- Enter the *Management Interface* IP Address, netmask, default router IP address, and optional VLAN identifier (a valid VLAN identifier, or '0' for untagged).

- Network Interface (Distribution System) Physical Port number:
  * Cisco 2000 Series Wireless LAN Controllers: 1 through 4 for a back panel Ethernet port
  * Cisco 4100 Series Wireless LAN Controllers: 1 or 2 for a front panel GigE port
  * Cisco 4400 Series Wireless LAN Controllers: 1 through 4 for a front panel GigE port
- Enter the IP address of the default DHCP Server that will supply IP Addresses to clients, the Cisco Wireless LAN Controller Management Interface, and optionally to the Service Port Interface.
- Enter the LWAPP Transport Mode, LAYER2 or LAYER3 (refer to *Layer 2 and Layer 3 LWAPP Operation*).
- Enter the Virtual Gateway IP Address; any fictitious, unassigned IP address (such as 1.1.1.1) to be used by Layer 3 Security and Mobility managers.
- Enter the *Cisco WLAN Solution Mobility Group* (RF Group) Name.
- Enter the WLAN 1 SSID, or Network Name. This is the default SSID that the Cisco 1000 Series lightweight access points broadcast when they associate with the Cisco Wireless LAN Controller.
- Allow or disallow Static IP Addresses for clients. (Yes = clients can supply their own IP Address. No = clients must request an IP Address from a DHCP server.)
- If you are configuring a RADIUS Server now, enter YES, and the RADIUS Server IP Address, communication port, and Secret. Otherwise, enter NO.
- Enter the Country Code for this installation. Type 'help' to list the supported countries, and refer to *Configuring the Cisco Wireless LAN Controller* and *Cisco WLAN Solution Supported Country Codes*.
- Independently enable and/or disable the 802.11b, 802.11a, and 802.11g Cisco 1000 Series lightweight access point networks.
- Enable or disable the *Radio Resource Management (RRM)* (Auto RF).

  The Cisco Wireless LAN Controller saves your configuration, reboots with your changes, and prompts you to log in or enter 'Recover-Config' to reset the Cisco Wireless LAN Controller to factory default configuration and return to the Startup Wizard.

Continue with *Using the Cisco WLAN Solution CLI*.

Adding SSL to the Web User Interface

When you plan to secure the Cisco Wireless LAN Controller HTTP: Web User Interface using the https: (HTTP + SSL) protocol, note that the Operating System automatically generates its own local Web Administration SSL certificate and automatically applies it to the Web User Interface. Verify whether or not the locally-generated Web Administration certificate is already loaded:

```
>show certificate summary
Web Administration Certificate..................... Locally Generated
Web Authentication Certificate..................... Locally Generated
Certificate compatibility mode:.................... off
```

Continue with either of the following two sections:

- *Locally-Generated Certificate* or an
- *Externally-Generated Certificate*.

Locally-Generated Certificate

Should you desire to have the Operating System generate a new Web Administration SSL certificate, complete the following:

- In the CLI, enter:

  ```
  >config certificate generate webadmin
  ```

  Wait a few seconds, and the Cisco Wireless LAN Controller returns:

  ```
  Web Administration certificate has been generated
  ```

- Verify that the Web Administration certificate is properly loaded:

  ```
  >show certificate summary
  Web Administration Certificate..................... Locally Generated
  Web Authentication Certificate..................... Locally Generated
  Certificate compatibility mode:.................... off
  ```

- Enable Secure Web mode:

  ```
  >config network secureweb enable
  ```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

  ```
  >save config

  Are you sure you want to save? (y/n) y

  Configuration Saved!
  ```

- Reboot the Cisco Wireless LAN Controller:

  ```
  >reset system

  Are you sure you would like to reset the system? (y/n) y

  System will now restart!
  ```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that operators using the Web User Interface know that they may securely log into the Cisco Wireless LAN Controller using “https://<Cisco Wireless LAN Controller_IPaddress>.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Externally-Generated Certificate

Should you desire to use your own Web Administration SSL certificate, complete the following:

- Make sure you have a TFTP server available for the certificate download:
  - If you are downloading through the Service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - If you are downloading through the DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.

  Note: The TFTP server cannot run on the same computer as the Cisco Wireless Control System, because the Cisco WCS and the TFTP server use the same communication port.

CAUTION: Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

- Buy or create your own Web Administration SSL key and certificate. If not already done, use a password, <private_key_password>, to encrypt the key and certificate in a .PEM encoded file. The PEM-encoded file is called a Web Administration Certificate file (<webadmincert_name>.pem).
- Move the <webadmincert_name>.pem file to the default directory on your TFTP server.
- Refer to the *Using the Cisco WLAN Solution CLI* section to connect and use the CLI.
- In the CLI, use the **transfer download start** command, and answer 'n' to the prompt, to view the current download settings:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Admin Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename.............................

Are you sure you want to start? (y/n) n

Transfer Canceled
```

- To change the download settings, use the following:

```
>transfer download mode tftp

>transfer download datatype webauthcert

>transfer download serverip <TFTP server IP address>

>transfer download path <absolute TFTP server path to the update file>

>transfer download filename <webadmincert_name>.pem
```

Note: Some TFTP servers require only a forward slash "/" as the **<TFTP server IP address>,** and the TFTP server automatically determines the path to the correct directory.

- Enter the password for the .PEM file, so Operating System can decrypt the Web Administration SSL key and certificate:

```
>transfer download certpassword <private_key_password>
>Setting password to <private_key_password>
```

- In the CLI, use the **transfer download start** command to view the updated settings, and answer 'y' to the prompt to confirm the current download settings and start the certificate and key download:

```
>transfer download start

Mode..................................... TFTP
Data Type................................ Site Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename............................ <webadmincert_name>

Are you sure you want to start? (y/n) y

TFTP Webadmin cert transfer starting.
```

```
Certificate installed.
  Please restart the switch (reset system) to use the new certificate.
```

- Verify that the Web Administration certificate is properly loaded:

```
>show certificate summary
Web Administration Certificate..................... Locally Generated
Web Authentication Certificate..................... Locally Generated
Certificate compatibility mode:.................... off
```

- Enable Secure Web mode:

```
>config network secureweb enable
```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

```
>save config

Are you sure you want to save? (y/n) y

Configuration Saved!
```

- Reboot the Cisco Wireless LAN Controller:

```
>reset system

Are you sure you would like to reset the system? (y/n) y

System will now restart!
```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that operators using the Web User Interface know that they may securely log into the Cisco Wireless LAN Controller using “https://<Cisco Wireless LAN Controller_IPaddress>.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Adding SSL to the 802.11 Interface

When you plan to use a Web Authorization (WebAuth) certificate to secure the Cisco Wireless LAN Controller when associating new clients, note that the Operating System automatically generates its own local Web Authentication SSL certificate and automatically applies them to the 802.11 Interface. Verify whether or not the locally-generated Web Authentication certificate is already loaded:

```
>show certificate summary
Web Administration Certificate..................... Locally Generated
Web Authentication Certificate..................... Locally Generated
Certificate compatibility mode:.................... off
```

Continue with one of the following two sections to add a *Locally-Generated Certificate* or an *Externally-Generated Certificate*.

Locally-Generated Certificate

Should you desire to have the Operating System generate another Web Authentication SSL certificate, complete the following:

- In the CLI, enter:

```
>config certificate generate webauth
```

- Wait a few seconds, and the Cisco Wireless LAN Controller returns:

```
Web Authentication certificate has been generated
```

- Verify that the Web Administration certificate is properly loaded:

```
>show certificate summary
Web Administration Certificate..................... Locally Generated
Web Authentication Certificate..................... Locally Generated
Certificate compatibility mode:.................... off
```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

```
>save config

Are you sure you want to save? (y/n) y

Configuration Saved!
```

- Reboot the Cisco Wireless LAN Controller:

```
>reset system

Are you sure you would like to reset the system? (y/n) y

System will now restart!
```

The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console Step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that client operators know that they may securely associate with the Cisco WLAN Solution.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Externally-Generated Certificate

Should you desire to use your own WebAuth SSL certificates, complete the following:

- Make sure you have a TFTP server available for the Operating System software download:
  - If you are downloading through the Service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - If you are downloading through the DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.

Note: The TFTP server cannot run on the same computer as the Cisco Wireless Control System, because the Cisco WCS and the TFTP server use the same communication port.

CAUTION: Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

- Buy or create your own WebAuth SSL key and certificate. If not already done, encode the key and certificate, virtual gateway IP Address, and a password, <private_key_password>, in a .PEM formatted file. The PEM-encoded file is called a WebAuth Site Certificate file (<webauthcert_name>.pem).
- Move the <webadmincert_name>.pem file to the default directory on your TFTP server.
- Refer to the *Using the Cisco WLAN Solution CLI* section to connect and use the CLI.

- In the CLI, use the **transfer download start** command, and answer 'n' to the prompt, to view the current download settings:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Site Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename.............................

Are you sure you want to start? (y/n) n

Transfer Canceled
```

- To change the download settings, use the following:

```
>transfer download mode tftp

>transfer download datatype webauthcert

>transfer download serverip <TFTP server IP address>

>transfer download path <absolute TFTP server path to the update file>

>transfer download filename <webauthcert_name>.pem
```

> **Note:** Some TFTP servers require only a forward slash "/" as the **<TFTP server IP address>,** and the TFTP server automatically determines the path to the correct directory.

- Enter the password included in the .PEM file, so the Operating System can decode the Web Administration SSL key and certificate:

```
>transfer download certpassword <private_key_password>
>Setting password to <private_key_password>
```

- In the CLI, use the **transfer download start** command to view the updated settings, and answer 'y' to the prompt to confirm the current download settings and start the certificate and key download:

```
>transfer download start
Mode..................................... TFTP
Data Type................................ Site Cert
TFTP Server IP........................... xxx.xxx.xxx.xxx
TFTP Path................................ <directory path>
TFTP Filename............................ <webauthcert_name>

Are you sure you want to start? (y/n) y

TFTP Webauth cert transfer starting.

TFTP receive complete... Installing Certificate.

Certificate installed.
  Please restart the switch (reset system) to use new certificate.
```

- Verify that the Web Administration certificate is properly loaded:

```
>show certificate summary
Web Administration Certificate................. Locally Generated
Web Authentication Certificate................. Locally Generated
Certificate compatibility mode:................ off
```

- Save the SSL certificate, key and secure web password in active working memory to NVRAM (non-volatile RAM) so your changes are retained across reboots:

```
>save config
Are you sure you want to save? (y/n) y
Configuration Saved!
```

- Reboot the Cisco Wireless LAN Controller:

```
>reset system
Are you sure you would like to reset the system? (y/n) y
System will now restart!
```

  The Cisco Wireless LAN Controller completes the bootup process as described in the Connecting and Using the CLI Console Step in the appropriate Cisco Wireless LAN Controller Quick Start Guide.

- Make sure that client operators know that they may securely associate with the Cisco WLAN Solution.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Saving Configurations

As described in *Cisco Wireless LAN Controller Memory*, the Cisco Wireless LAN Controller contains two kinds of memory: volatile RAM and NVRAM. At any time, you can save the configuration changes from active volatile RAM to non-volatile RAM (NVRAM) using one of three commands:

- Use the **save config** command as detailed below.
- Use the **reset system** command, described in *Resetting the Cisco Wireless LAN Controller*, which will ask you whether you would like to save configuration changes before the system reboots.
- Use the **logout** command, described in *Logging Out of the CLI*, which asks you whether you would like to save configuration changes before logging out.

To save the configurations without resetting the Cisco Wireless LAN Controller or logging out of the CLI, type:

```
>save config
Are you sure you want to save? (y/n)
```

Enter '**y**' to save the current configurations from volatile RAM to non-volatile RAM (NVRAM).

You can now continue using the system, log out, or reboot knowing that the Cisco Wireless LAN Controller will come up in the same configuration after reboot.

Continue with *Using the Cisco WLAN Solution CLI*.

Clearing Configurations

As described in *Cisco Wireless LAN Controller Memory*, the Cisco Wireless LAN Controller contains two kinds of memory: volatile RAM and NVRAM. To clear the active configuration in the non-volatile RAM, complete the following.

- To clear the Cisco Wireless LAN Controller configuration from non-volatile RAM, use the **clear config** command:

  ```
  >clear config
  Are you sure you want to clear the configuration? (y/n)
  ```

  Enter '**y**' to clear the current configurations from non-volatile RAM.

- After clearing the Cisco Wireless LAN Controller configuration in NVRAM, perform a "Reboot without Save":

  ```
  >reset system
  The system has unsaved changes.
  Would you like to save them now? (y/n)
  ```

  Enter "**n**" to reset the Cisco Wireless LAN Controller without saving any outstanding configuration changes from volatile RAM to non-volatile RAM.

- When the Cisco Wireless LAN Controller reboots, the Operating System displays the Startup Wizard.

Continue with *Using the Cisco WLAN Solution CLI*.

Erasing the Cisco Wireless LAN Controller Configuration

The Wireless LAN operator may wish to move a Cisco Wireless LAN Controller to a different location and reconfigure it.

If the moved Cisco Wireless LAN Controller uses the same or nearly the same configuration, use the Cisco Wireless Control System, Web User Interface, or Command Line Interface to reconfigure individual Cisco Wireless LAN Controller parameters.

If the moved Cisco Wireless LAN Controller uses a significantly different configuration, erase the Cisco Wireless LAN Controller configuration using the following procedure.

- Enter the **reset system** command. The reset script prompts you if there are any unsaved changes. Enter '**y**' to save changes from active volatile RAM to NVRAM before rebooting the Cisco Wireless LAN Controller.

  The Cisco Wireless LAN Controller reboots.

- When you are prompted for a User Name, enter **recover-config** to restore the factory default configurations.

  The Cisco Wireless LAN Controller reboots and displays the `Welcome to the Cisco WLAN Solution Wizard Configuration Tool` message.

- Enter the initial configuration of the Cisco Wireless LAN Controller as described in *Using the Startup Wizard*.

Continue with *Using the Cisco WLAN Solution CLI*.

Resetting the Cisco Wireless LAN Controller

After you have installed and configured a Cisco Wireless LAN Controller, you can reset the Cisco Wireless LAN Controller and view the reboot process on the CLI console using one of the following two methods:

- Unplug the Cisco Wireless LAN Controller from its power source.
- Enter the **reset system** command. The reset script prompts you if there are any unsaved changes. Enter '**y**' to save changes from active volatile RAM to NVRAM (non-volatile RAM) before rebooting the Cisco Wireless LAN Controller.

  Note: If you have already cleared the active volatile RAM as described in *Clearing Configurations*, entering '**n**' in response to this prompt prevents the volatile RAM to NVRAM (non-volatile RAM) from overwriting the cleared configuration in NVRAM. In this case you will be directed to the Startup Wizard.

When the Cisco Wireless LAN Controller reboots, the CLI console displays the following reboot information:

- Initializing the system.
- Verifying the hardware configuration.
- Loading microcode into memory.
- Verifying the Operating System software load.
- Initializing with its stored configurations.
- Displaying the login prompt.

You have seen the boot process on the CLI console. Either unplug your serial connection, or enter a valid login and password to reenter the CLI.

Continue with *Using the Cisco WLAN Solution CLI*.

Using the Cisco Wireless Control System

Refer to the following to start, stop, use, and manage Cisco WCS.

- *Starting and Stopping Windows Cisco WCS*
  - *Starting Cisco WCS as a Windows Application*
  - *Starting Cisco WCS as a Windows Service*
  - *Stopping the Cisco WCS Windows Application*
  - *Stopping the Cisco WCS Windows Service*
  - *Checking the Cisco WCS Windows Service Status*
- *Starting and Stopping Linux Cisco WCS*
  - *Starting the Linux Cisco WCS Application*
  - *Stopping the Linux Cisco WCS Application*
  - *Cisco WCSChecking the Linux Cisco WCS Status*
- *Starting and Stopping the Cisco WCS Web Interface*
  - *Starting a Cisco WCS User Interface*
  - *Stopping a Cisco WCS User Interface*
- *Using Cisco WCS*
  - *Checking the Cisco WLAN Solution Network Summary*
  - *Adding a Cisco Wireless LAN Controller to Cisco WCS*
  - *Creating an RF Calibration Model*
  - *Adding a Campus Map to the Cisco WCS Database*
  - *Adding a Building to a Campus*
  - *Adding a Standalone Building to the Cisco WCS Database*
  - *Adding an Outdoor Area to a Campus*
  - *Adding Floor Plans to a Campus Building*
  - *Adding Floor Plans to a Standalone Building*
  - *Using Map Editor*
  - *Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Open Area Maps*
  - *Monitoring Predicted Coverage (RSSI)*
  - *Monitoring Channels on a Floor Map*
  - *Monitoring Transmit Power Levels on a Floor Map*
  - *Monitoring Coverage Holes on a Floor Map*
  - *Monitoring Users on a Floor Map*
  - *Monitoring Clients on a Floor Map*
- *Troubleshooting with Cisco WCS*
  - *Checking the Cisco WLAN Solution Network Summary*
  - *Viewing Current Cisco Wireless LAN Controller Status and Configurations*
  - *Viewing Cisco WCS Statistics Reports*
  - *Detecting and Locating Rogue Access Points*

  - *Acknowledging Rogue Access Points*
  - *Locating Clients*
  - *Finding Coverage Holes*
  - *Pinging a Network Device from a Cisco Wireless LAN Controller*
- *Updating OS Software from Cisco WCS*
- *Managing Cisco WCS and Database*
  - *Installing Cisco WCS*
  - *Updating the Windows Cisco WCS*
  - *Updating the Linux Cisco WCS*
  - *Reinitializing the Windows Cisco WCS Database*
  - *Updating the Linux Cisco WCS*

Starting and Stopping Windows Cisco WCS

- *Starting Cisco WCS as a Windows Application*
- *Starting Cisco WCS as a Windows Service*
- *Stopping the Cisco WCS Windows Application*
- *Stopping the Cisco WCS Windows Service*
- *Checking the Cisco WCS Windows Service Status*

Starting Cisco WCS as a Windows Application

When the Cisco WCS has been installed as an application, you can start the Cisco WCS application at any time.

- From the Windows **START** button, select the **Programs** menu, and click **Wireless Control System / Start WCS**.

  The start Cisco WCS script opens a **Start WCS** DOS window, which displays many `Created table` and `Process: Started` messages.

When the **Start WCS** DOS window displays `Please connect your client to the web server on port 80`, the Cisco WCS has started and is ready to host Cisco WCS User Interfaces (clients).

> **CAUTION:** The Cisco WCS may display **Start Cisco WCS Server**, **Solid Database**, and **Apache** windows, which you can minimize. DO NOT CLOSE any of these windows, or you can abnormally halt the Cisco WCS. When you plan to shut down the Cisco WCS, refer to *Stopping the Cisco WCS Windows Application* or *Stopping the Cisco WCS Windows Service*.

If desired, continue with *Starting and Stopping the Cisco WCS Web Interface*.

Starting Cisco WCS as a Windows Service

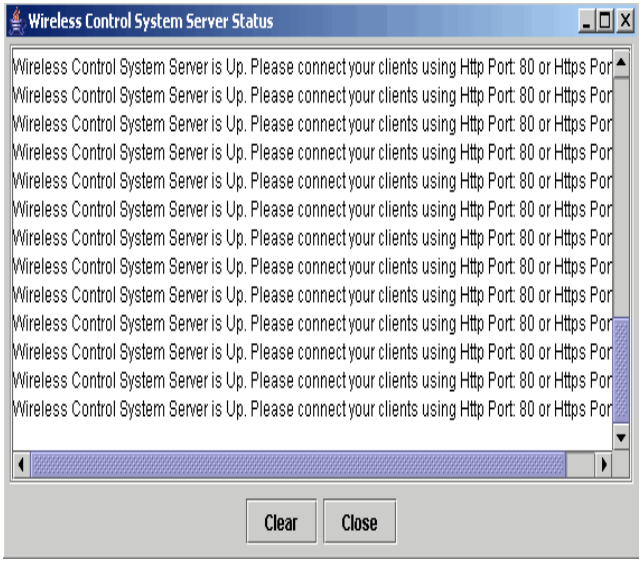
When the Cisco WCS has been installed as a service, you can start the Cisco WCS service at any time.

- From the Windows **START** button, select the **Programs** menu, and select **Wireless Control System / Start WCS**.

  The start Cisco WCS script opens a **Start WCS** DOS window, which displays the following messages:

  ```
  The Nms Server service is starting. .                (in the background)
  The Nms Server service was started successfully.
  Launching Server Status Window
  ```

  The **Start WCS DOS** window displays the **Wireless Control System Status** window. You can close the **Start WCS** DOS window, and view the current Cisco WCS Service status in the **Wireless Control System Status** window. When the **Wireless Control System Status** window displays the `Wireless Control System Server is Up` message, the Cisco WCS service has started and is ready to host Cisco WCS User Interfaces (clients).


Wireless Control System Server Status
Wireless Control System Server is Up. Please connect your clients using Http Port: 80 or Https Por
Clear
Close

  Note that the **Wireless Control System Status** window is updated about every five seconds.

  Note: You can close the **Wireless Control System Status** window at any time you wish. When you want to view the current Cisco WCS status, from the Windows **START** button, select the **Programs** menu, and select **Wireless Control System / Check Server Status** to view the **Wireless Control System Status** window again.

If desired, continue with *Starting a Cisco WCS User Interface*.

Stopping the Cisco WCS Windows Application

You can stop the Cisco WCS application at any time.

> **Note:** If there are any Cisco WCS User Interfaces logged in when you stop the Cisco WCS, the Cisco WCS User Interface sessions stop functioning.

- From the Windows **START** button, select the **Programs** menu, and select **Wireless Control System / Stop WCS**.

  The stop Cisco WCS script opens a **Stop WCS** DOS window, which displays the **Shutdown Web NMS Server** window.

- The **Stop WCS** window displays the `Press any key to continue` prompt.
- Press any key to complete the stop Cisco WCS script.

You have shut down the Cisco WCS application.

Stopping the Cisco WCS Windows Service

You can stop the Cisco WCS service at any time.

> **Note:** If there are any Cisco WCS User Interfaces logged in when you stop the Cisco WCS, the Cisco WCS User Interface sessions stop functioning.

- From the Windows **START** button, select the **Programs** menu, and select **Wireless Control System / Stop WCS**.

  The stop Cisco WCS script opens a **Stop WCS** DOS window and halts the Cisco WCS service.

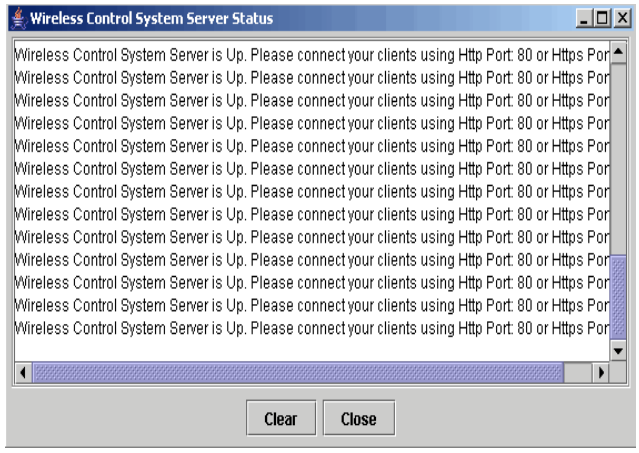
You have shut down the Cisco WCS service.

Checking the Cisco WCS Windows Service Status

When Cisco WCS is installed as a Service, it runs in the background. That is, it has no windows open, so you cannot directly view its current status. To allow you to check the Cisco WCS Service status, the Cisco WLAN Solution has a convenient Cisco WCS Status utility.

- To activate the Cisco WCS Status utility, from the Windows **START** button, select the **Programs** menu, and select **Wireless Control System / Check Server Status**.

  The Check Server Status script launches the **Check Server Status** DOS window, which in turn launches the **Wireless Control System Server Status** window.


Wireless Control System Server Status
Wireless Control System Server is Up. Please connect your clients using Http Port: 80 or Https Por
Clear
Close

  When the Cisco WCS Service is active, the Wireless Control System Server Status window reports that the `Wireless Control System Server is Up`. When the Cisco WCS Service is inactive, the **Wireless Control System Server Status** window reports that the `Wireless Control System Server is down. Checking if database has started ...`

- You can close the **Check Server Status** DOS window and the **Wireless Control System Server Status** window at any time.

You have viewed the Cisco WCS service status.

Starting and Stopping Linux Cisco WCS

- *Starting the Linux Cisco WCS Application*
- *Stopping the Linux Cisco WCS Application*
- *Cisco WCSChecking the Linux Cisco WCS Status*

Starting the Linux Cisco WCS Application

Linux Cisco WCS is always installed as an application, and you can start the Linux Cisco WCS application at any time.

When Cisco WCS has been installed on the Linux Cisco WCS Server, you can start Cisco WCS at any time.

- If not already done, log in as root.
- Using the Linux command line interface, navigate to the default **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./StartWCS** to start the Cisco WCS.
- Enter **./CheckServerStatus** to open the **Wireless Control System Server Status** window.

When the Start Wireless Control System Server Status window displays `Wireless Control System Server is up. Please connect your clients (Cisco WCS User Interfaces) using Http Port: 80 or Https Port: 433` (or whichever HTTP: or HTTPS: port you selected when installing the Cisco WCS), the Cisco WCS has started and is ready to host Cisco WCS User Interfaces.

> **CAUTION:** When you plan to shut down the Linux Cisco WCS, refer to *Stopping the Linux Cisco WCS Application*.

If desired, continue with *Starting and Stopping the Cisco WCS Web Interface*.

Stopping the Linux Cisco WCS Application

You can stop the Cisco WCS Linux application at any time.

> **Note:** If there are any Cisco WCS User Interfaces logged in when you stop the Cisco WCS, the Cisco WCS User Interface sessions will stop functioning.

- If not already done, log in as root.
- Using the Linux command line interface, navigate to the default **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./StopWCS** to stop the Cisco WCS application.

You have shut down the Cisco WCS application.

Checking the Linux Cisco WCS Status

You can check the status of the Linux Cisco WCS at any time.

- Using the Linux command line interface, navigate to the default **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./CheckServerStatus** to view the **Wireless Control System Server Status** window. The Wireless Control System Server Status window shows `Wireless Control System Server is up. Please connect your clients using Http Port: 80 or Https Port: 433` when the Cisco WCS is running. The Wireless Control System Server Status window typically shows `Wireless Control System Server is down. Checking if database has started...` when the Cisco WCS is not running.
- To close the Wireless Control System Server Status window, click **Close** in the Wireless Control System Server Status window or enter **<CTRL-C>** in the **./StartWCS** window.

You have viewed the Cisco WCS service status.

Starting and Stopping the Cisco WCS Web Interface

Starting a Cisco WCS User Interface

This Cisco WCS interface is used by Cisco WCS operators as described in Cisco WCS User Interface. Starting a Cisco WCS User Interface is a simple task.

- If not already done, start the Cisco WCS as described in *Starting and Stopping Windows Cisco WCS* or *Starting and Stopping Linux Cisco WCS*.
- Launch Internet Explorer 6.0.

  Note: Some documented features may not function properly if you choose to use any Web Browser other than Internet Explorer 6.0 on a Windows workstation.

  `https://<localhost|Cisco WCS IP Address>`

  Example: `https://176.89.43.44.`

  where:

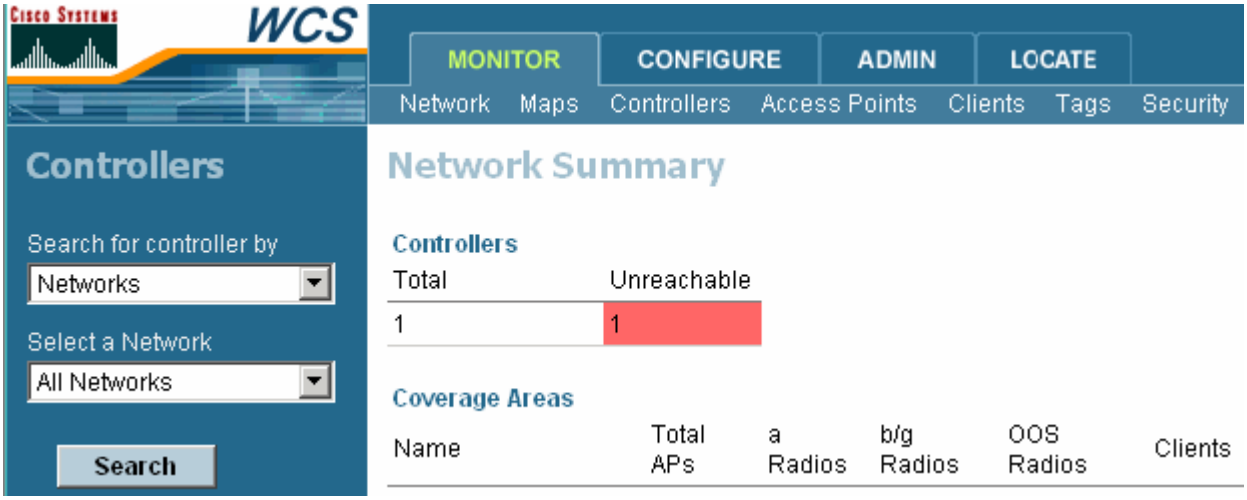
  - **`https://`** is a secure (http + Secure Sockets Layer) login, to which the Cisco WCS usually returns a Security Alert message before continuing.
  - **`localhost`** is used when the Cisco WCS User Interface is on the Cisco WCS Server.

    Note: It is recommended that the Cisco WCS User Interface and Cisco WCS are installed on different machines.

  - **`Cisco WCS IP Address`** is the IP Address of the Cisco WCS on any other workstation.

  The Cisco WCS User Interface displays the **Cisco WCS Login** page.
- In the Cisco WCS Login page, enter the following information:
  - User Name: Your username (default **`root`**).
  - Password: Your password (default **`public`**).
- When you have made these entries in the Cisco WCS Login page, click **Submit**.

The Cisco WCS User Interface is now active and available for your use, and displays the Network Summary (Network Dashboard) similar to the following figure, which provides a summary of the Cisco WLAN Solution, including reported coverage holes, Cisco 1000 Series lightweight access point operational data, most recent detected rogue access points, and client distribution over time.



Continue with the *Using the Cisco Wireless Control System* or *Stopping a Cisco WCS User Interface* section.

Stopping a Cisco WCS User Interface

- *Manually Stopping the Cisco WCS User Interface*
- *Cisco WCS Shutdown Stopping the Cisco WCS User Interface*

Manually Stopping the Cisco WCS User Interface

- When you are finished working in the Cisco WCS User Interface application, exit the Cisco WCS User Interface application page by clicking **Logout** in the upper right corner of the Cisco WCS User Interface page. The Cisco WCS User Interface displays the **Cisco WCS Login** page.

  Note that you can return to the previous cached screen in the web browser. However, if you attempt to access any of the parameters in that screen, you are returned to the **Cisco WCS Login** page.

- Alternatively, you can shut down the web browser.

The Cisco WCS User Interface window shuts down, leaving the Cisco WCS running.

Cisco WCS Shutdown Stopping the Cisco WCS User Interface

Occasionally, the system administrator may stop the Cisco WCS while a Cisco WCS User Interface is logged in. Should this happen, the web browser displays a `The page cannot be displayed` message.

> **Note:** When the Cisco WCS User Interface has been stopped by a Cisco WCS Server shutdown, it does not reassociate with the Cisco WCS when the Cisco WCS Server restarts. You must restart the Cisco WCS User Interface as described in *Starting a Cisco WCS User Interface*.

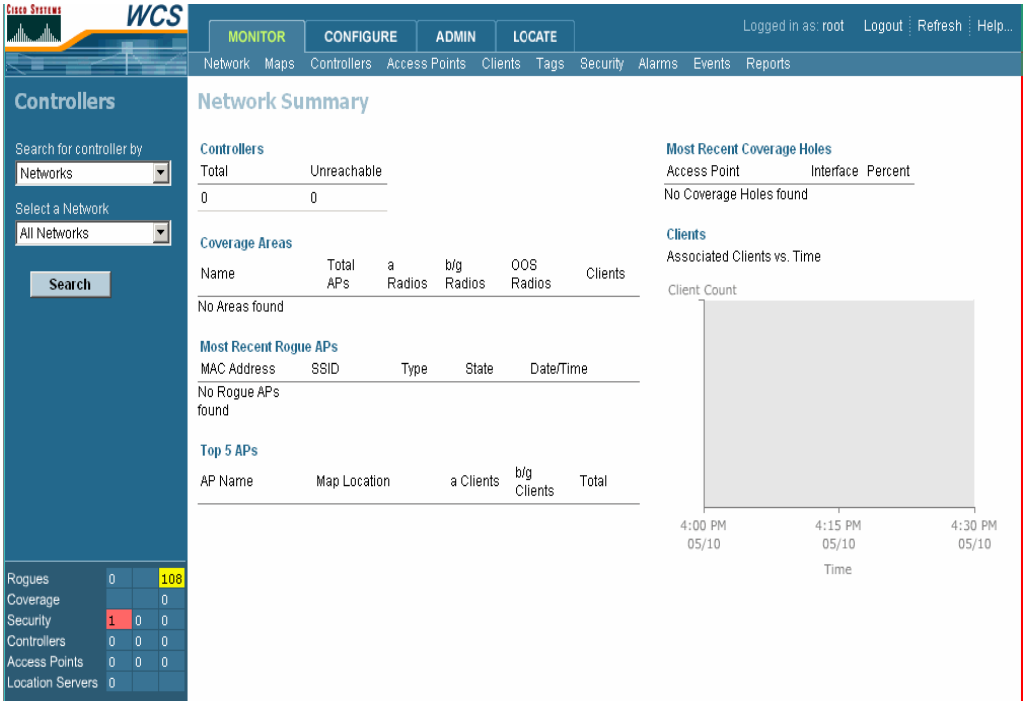
Using Cisco WCS

- *Checking the Cisco WLAN Solution Network Summary*
- *Adding a Cisco Wireless LAN Controller to Cisco WCS*
- *Creating an RF Calibration Model*
- *Adding a Campus Map to the Cisco WCS Database*
- *Adding a Building to a Campus*
- *Adding a Standalone Building to the Cisco WCS Database*
- *Adding an Outdoor Area to a Campus*
- *Adding Floor Plans to a Campus Building*
- *Adding Floor Plans to a Standalone Building*
- *Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Open Area Maps*
- *Monitoring Predicted Coverage (RSSI)*
- *Monitoring Channels on a Floor Map*
- *Monitoring Transmit Power Levels on a Floor Map*
- *Monitoring Coverage Holes on a Floor Map*
- *Monitoring Users on a Floor Map*
- *Monitoring Clients on a Floor Map*

Checking the Cisco WLAN Solution Network Summary

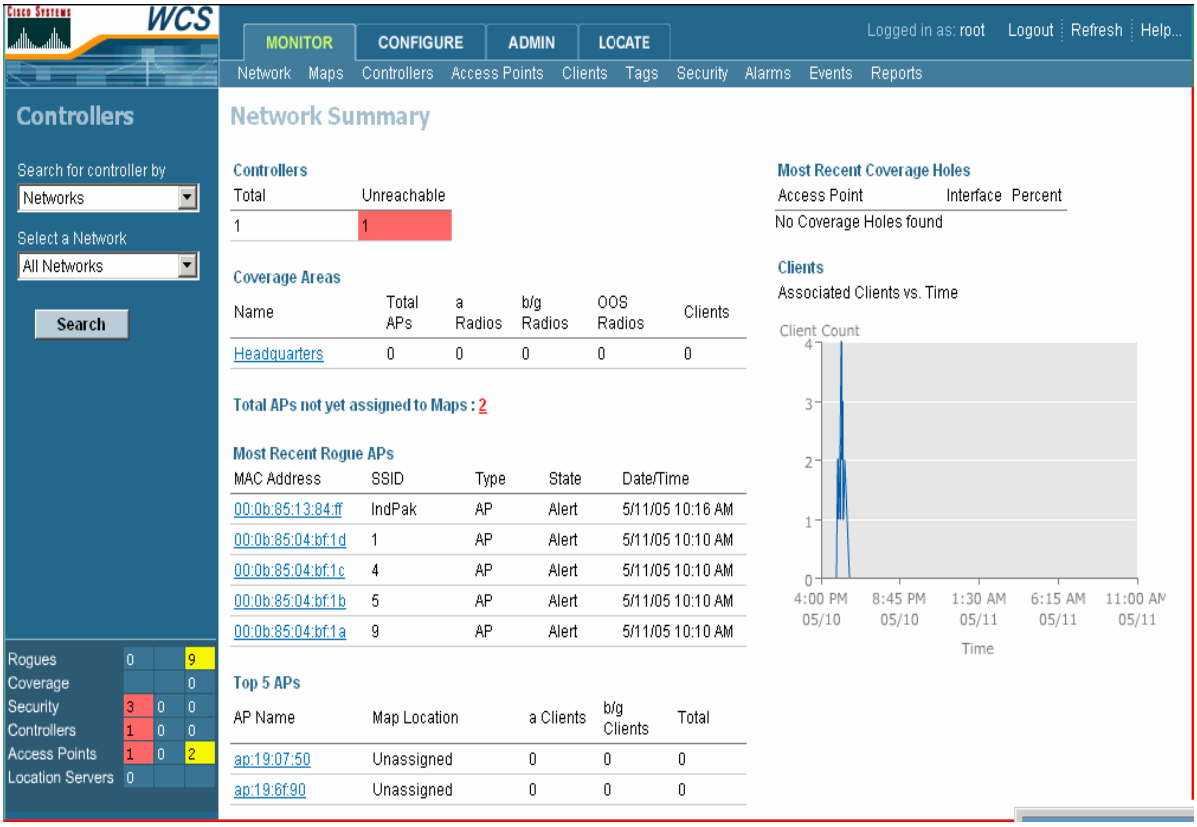
When you use Cisco WCS for the first time, the Network Summary page shows that the Cisco Wireless LAN Controllers, Coverage Areas, Most Recent Rogue Access Points, Top Five Cisco 1000 Series light-weight access points, and the Most Recent Coverage Holes database is empty, as shown in the following figure. The following figure also shows that there are no Clients connected to the Cisco WLAN Solution at this time.

Figure - Network Summary for Unconfigured Cisco WCS Database



After you have configured the Cisco WCS database with one or more Cisco Wireless LAN Controllers, the Network Summary page shows that the Cisco Wireless LAN Controllers, Coverage Areas, Most Recent Rogue Access Points, the Top Five Cisco 1000 Series lightweight access points, and the Top Five Coverage Holes databases are updated, as shown in the following figure. The following figure also shows that there has been one Client connected to the Cisco WLAN Solution over the last 24 hours.

Figure - Network Summary for Configured Cisco WCS Database

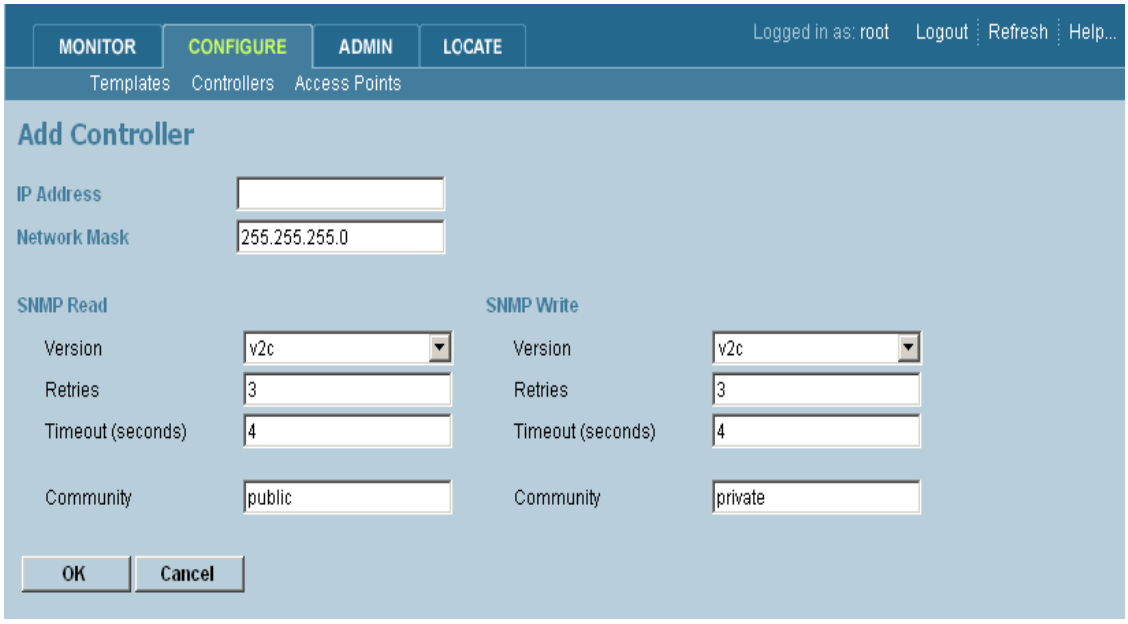


Adding a Cisco Wireless LAN Controller to Cisco WCS

When you know the IP Address of a Cisco Wireless LAN Controller Service Port or a Cisco Wireless LAN Controller name, do the following to add the Cisco Wireless LAN Controller to the Cisco WCS database.

> **Note:** Cisco recommends that you manage Cisco Wireless LAN Controllers via the dedicated Service Port for improved security. When you are managing a Cisco 4100 Series Wireless LAN Controller or a Cisco 4400 Series Wireless LAN Controller that has its Service port disabled, and when you are managing a Cisco 2000 Series Wireless LAN Controller (which has no Service Port), you must manage the Cisco Wireless LAN Controller through its Management Interface.

- Select **Configure/Controllers** to have Cisco WCS display the **All Controllers** page.
- From the **Select a command** drop-down menu, select **Add Controller** and click GO to display the **Add Controller** page.



- Enter the Cisco Wireless LAN Controller IP Address, Network Mask, and required SNMP settings in the **Add Controller** data entry fields.

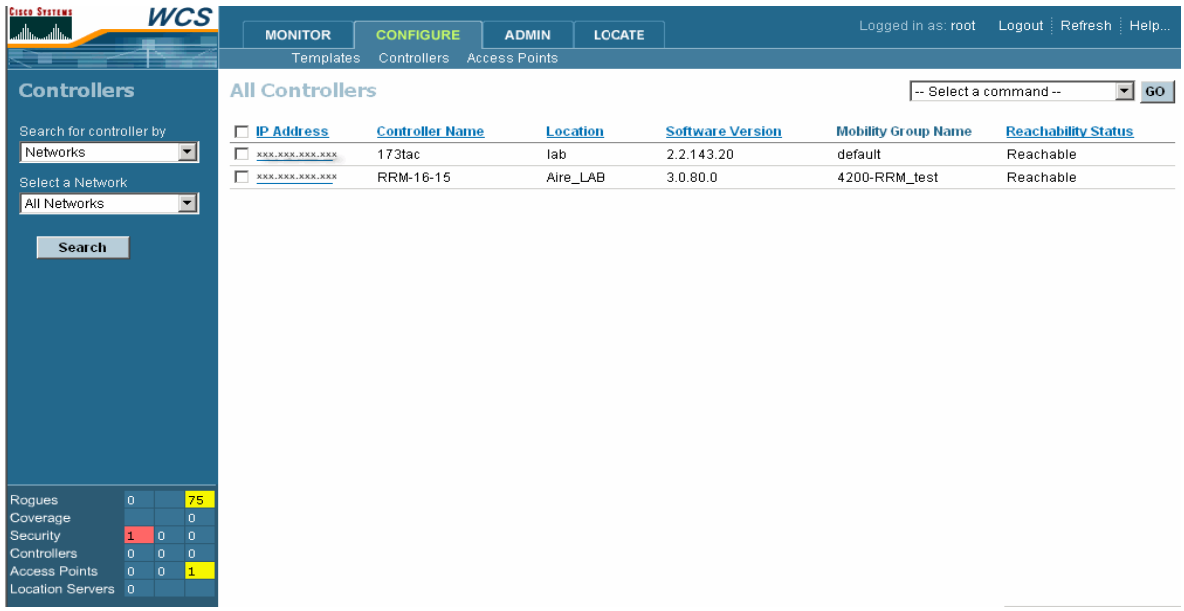
> **Note:** Cisco recommends that you manage each Cisco Wireless LAN Controller via the dedicated Service Port for highest security. If any Cisco Wireless LAN Controller has its Service ports disabled, you will manage the Cisco Wireless LAN Controller through its Management Interface.

> **Note:** Cisco Wireless LAN Controllers are factory-configured with SNMP Version 2C enabled, which is the most secure and slowest version. After you have logged into the Cisco Wireless LAN Controller, you can change the SNMP parameters and re-add the Cisco Wireless LAN Controller to the Cisco WCS database.

- Click **OK**, and the Cisco WCS User Interface displays the **Please wait. . .** dialog screen while it contacts the Cisco Wireless LAN Controller, adds the current Cisco Wireless LAN Controller configuration to the Cisco WCS database, and then returns you to the **Add Controller** page.

  Note: If Cisco WCS does not find a Cisco Wireless LAN Controller at the selected IP Address, the **Discovery Status** page displays a `No response from device, check SNMP. . .` message. Either the Service Port IP Address is set incorrectly (refer to *Configuring Other Ports and Parameters*), or Cisco WCS was unable to contact the Cisco Wireless LAN Controller (make sure that you can ping the Cisco Wireless LAN Controller from the Cisco WCS Server and retry), or the device has different SNMP settings (verify that the SNMP settings match and retry).

- You may now add additional Cisco Wireless LAN Controllers in the **Add Controller** page, or click the Configure Tab to have the Cisco WCS User Interface display the **All Controllers** page.



You have added Cisco Wireless LAN Controllers to the Cisco WCS database. Continue *Using the Cisco Wireless Control System*.

Creating an RF Calibration Model

When you are using Cisco Wireless Control System with Location Services and want to improve client and rogue access point location accuracy across one or more floors, you can create an RF Calibration Model that uses manually-collected RF measurements to calibrate the location algorithm.

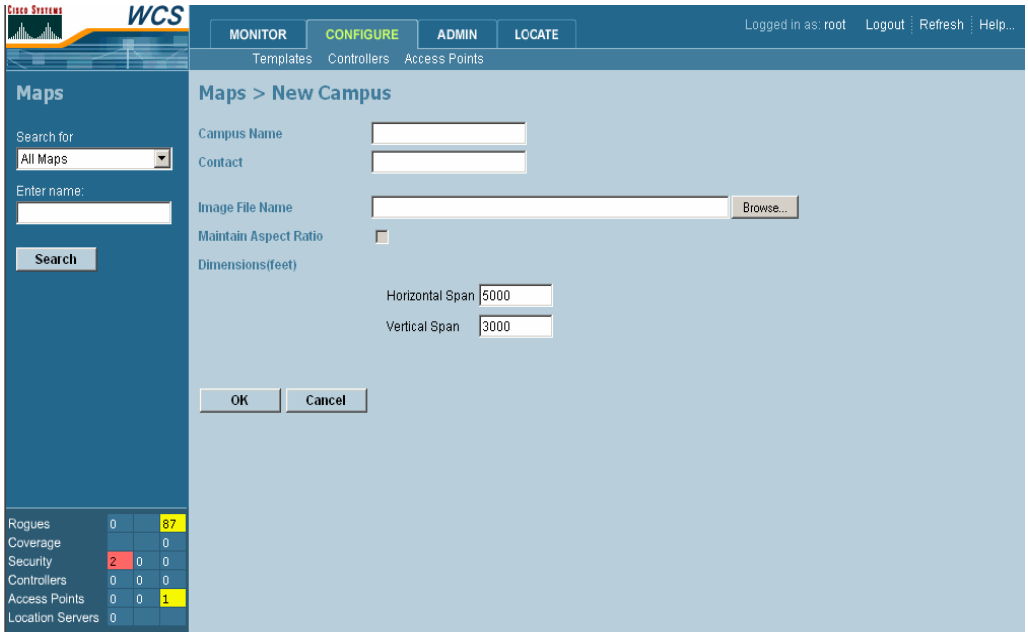
When you have multiple floors in a building with the same physical layout as the calibrated floor, you can save time calibrating the remaining floors by applying the same RF Calibration Model to the remaining floors.

Follow the RF Calibration procedures included in the Cisco WCS Web Interface Online Help to create an RF Prediction Model.

Adding a Campus Map to the Cisco WCS Database

Rather than forcing the Cisco WCS operator to use only a text-based map to manage the Cisco Wireless LAN Solution (Cisco WLAN Solution), Cisco WCS allows the operator to view the managed System on realistic campus, building, and floor plan maps. This section describes how to add a single campus map to the Cisco WCS database.

- First, save your maps in .PNG, .JPG, .JPEG, or .GIF format. They can be any size, as Cisco WCS automatically resizes the map to fit in its working areas.
- Browse to and import the map(s) from anywhere in your file system.
- Select the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- From the **Select a command** drop-down menu, select **New Campus** and click **GO** to have the Cisco WCS User Interface display the **Maps > New Campus** page.



- In the **Maps > New Campus** page, enter the Campus Name and Campus Contact Information, click Browse to search for and select the Campus graphic name, select Maintain Aspect Ratio (if desired), and enter the Horizontal Span and the Vertical Span of the map in feet. (Note that the Campus Horizontal Span and the Vertical Span should be larger than any building or floor plan to be added to the campus.)
- Click **OK** to add the Campus Map to the Cisco WCS database. The Cisco WCS User Interface displays the **Maps** page.

  The **Maps** page contains a current list of Campus Names, the map type (Campus or Building), and the current Campus Status (Green for OK, Red for Failure, Amber for Alarm).
- You have added a map to the Cisco WCS database, which corresponds to a single Campus.

- Ensure that the graphic has been added correctly by clicking the new Campus Name to have the Cisco WCS User Interface display the **Maps > <Campus Name>** page as shown in the following figure.

- Repeat this section for any remaining Campuses.

When you have completed this section, continue with *Adding an Outdoor Area to a Campus* or *Adding a Standalone Building to the Cisco WCS Database*.

Adding a Building to a Campus

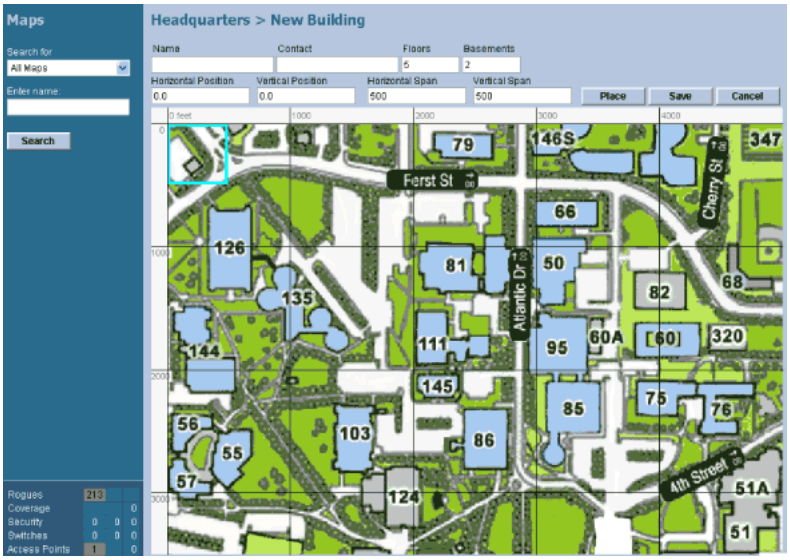
You can add Buildings to the Cisco WCS database whether or not you have added maps or Campuses as described in *Adding a Campus Map to the Cisco WCS Database*.

To add a Building to the Cisco WCS database without associating it with a Campus, continue with *Adding a Standalone Building to the Cisco WCS Database*. To add an Outdoor Area to a Campus in the Cisco WCS database, continue with *Adding an Outdoor Area to a Campus*. Otherwise, add a Building to a Campus in the Cisco WCS database by performing the following steps:

- Select the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- In the Maps Page, select the desired **Campus**.

  The Cisco WCS User Interface displays the **Maps > <Campus Name>** page.

- From the **Select a command** drop-down menu, select **New Building** and click **GO** to have the Cisco WCS User Interface display the **<Campus Name> > New Building** page.

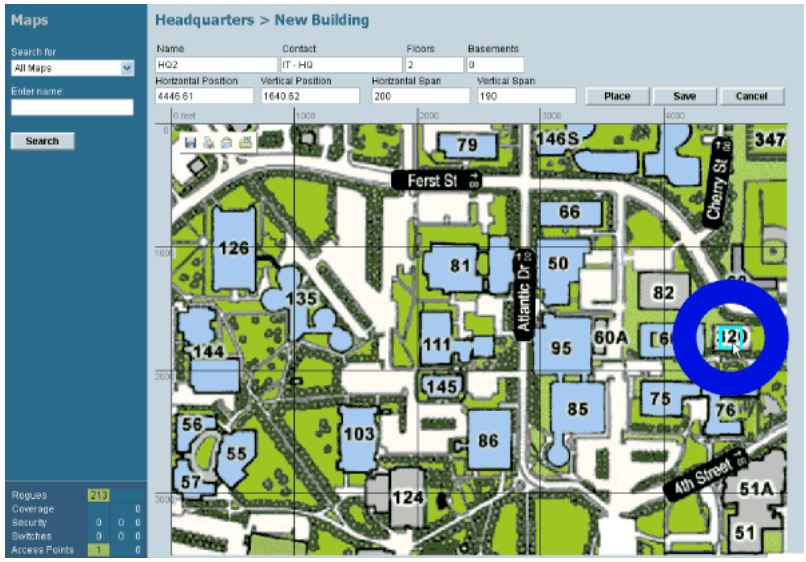


- In the **<Campus Name> > New Building** page, you can create a virtual Building to organize related Floor Plan maps. To do this:
  - Enter the Building Name.
  - Enter the Building Contact Name.
  - Enter the number of Floors and Basements.
  - Enter an approximate Building Horizontal Span and Vertical Span (width and depth on the map) in feet. Note that these numbers should be larger than or the same size as any floors that might be added later.

    Note: Alternatively, you can use **<CTRL-Left-Click>** to resize the bounding area in the upper left corner of the Campus map. As you change the size of the bounding area, the Building Horizontal Span and Vertical Span parameters vary to match your changes.

  - Click **Place** to locate the Building on the Campus map. Cisco WCS creates a Building rectangle scaled to the size of the Campus map.

- Click on the Building rectangle and drag it to the desired position on the Campus map.



- Click **Save** to save the Building definition and its Campus location in the Cisco WCS database. Cisco WCS saves the Building name in the Building rectangle on the Campus map. Note that there will be a hyperlink associated with the Building that takes you to the corresponding Map page.

- Repeat this section for any remaining Campus Buildings.

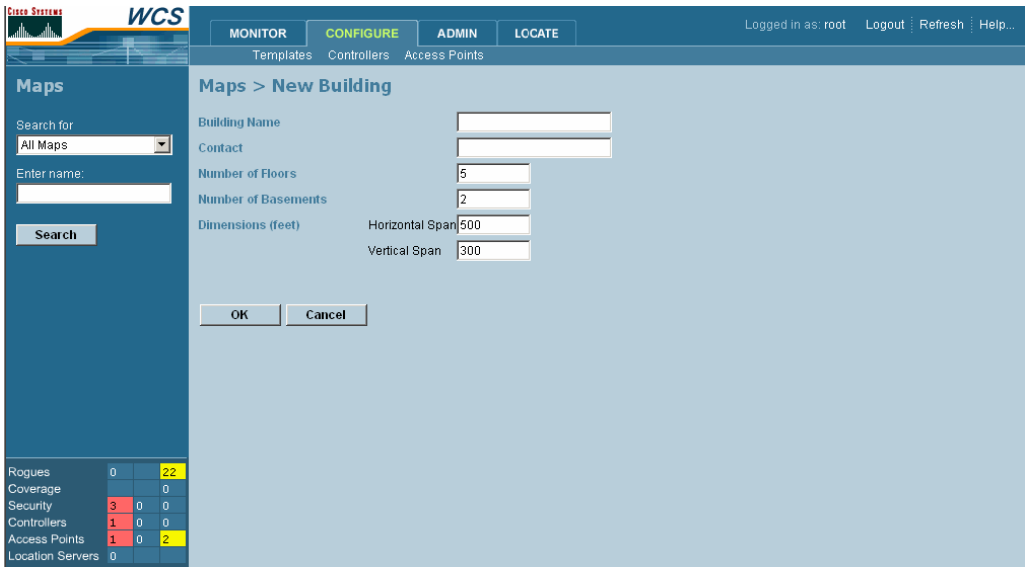
When you have completed this section for all Campus Buildings, continue with *Adding Floor Plans to a Campus Building*.

Adding a Standalone Building to the Cisco WCS Database

You can add Buildings to the Cisco WCS database whether or not you have added maps or Campuses as described in *Adding a Campus Map to the Cisco WCS Database*.

To add a building to a Campus in the Cisco WCS database, continue with *Adding a Building to a Campus*. To add an Outdoor Area to a Campus in the Cisco WCS database, continue with *Adding an Outdoor Area to a Campus*. Otherwise, add a standalone building to a Campus by performing the following steps:

- Select the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- From the **Select a command** drop-down menu, select **New Building** and click **GO** to have the Cisco WCS User Interface display the **Maps > New Building** page.



- In the **Maps > New Building** page, you can create a virtual Building to organize related Floor Plan maps. To do this:
  - Enter the Building Name.
  - Enter the Building Contact Name.
  - Enter the number of Floors and Basements.
  - Enter an approximate Building Horizontal Span and Vertical Span (width and depth on the map) in feet. Note that these numbers should be larger than or the same as any floors that might be added later.
  - Click **OK** to save the Building definition to the Cisco WCS database.
- Repeat this section for any remaining Standalone Buildings.

When you have completed this section for all Standalone Buildings, continue with *Adding Floor Plans to a Standalone Building*.

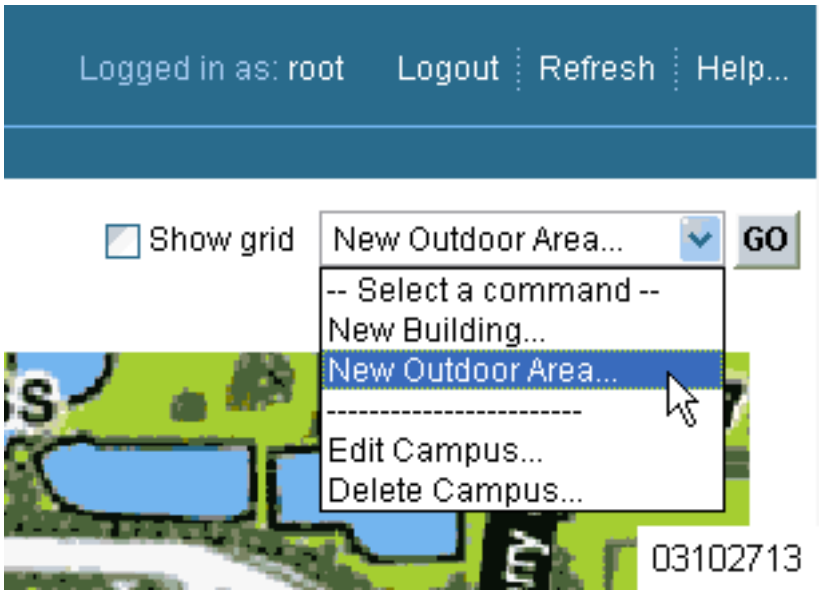
Adding an Outdoor Area to a Campus

You can add Outdoor Areas to a Campus in the Cisco WCS database whether or not you have added Outdoor Area maps to the Cisco WCS database.

To add a building to the Cisco WCS database without associating it with a Campus, continue with *Adding a Standalone Building to the Cisco WCS Database*. To add a building to a Campus in the Cisco WCS database, continue with *Adding a Building to a Campus*. Otherwise, add an Outdoor Area to a Campus by performing the following steps:

- If desired, save Outdoor Area maps in .PNG, .JPG, .JPEG, or .GIF format. Note that you do not need to have a map for the Outdoor Area map(s). The maps can be any size, as Cisco WCS automatically resizes the map(s) to fit in its working areas.
- Browse to and import the map(s) from anywhere in your file system.
- Highlight the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- In the Maps Page, select the desired **Campus**.

  The Cisco WCS User Interface displays the **Maps > <Campus Name>** page.
- From the **Select a command** drop-down menu, select **New Outdoor Area**.



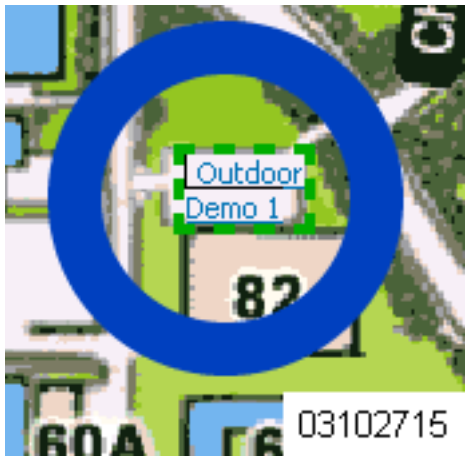
- Click **GO** to have the Cisco WCS User Interface display the **<Campus Name> > New Outdoor Area** page.

- In the **<Campus Name> > New Outdoor Area** page, you can create a manageable Outdoor Area. To do this:
  - Enter the Outdoor Area Name.
  - Enter the Outdoor Area Contact Name.
  - Enter the Outdoor Area Map filename (optional).
  - Enter an approximate Outdoor Area Horizontal Span and Vertical Span (width and depth on the map) in feet.

  Note: Alternatively, you can use **<CTRL-Left-Click>** to resize the bounding area in the upper left corner of the Campus map. As you change the size of the bounding area, the Building Horizontal Span and Vertical Span parameters vary to match your changes.

  - Click **Place** to locate the Outdoor Area on the Campus map. Cisco WCS creates an Outdoor Area rectangle scaled to the size of the Campus map.
  - Left-click on the Outdoor Area rectangle and drag it to the desired position on the Campus map.

- Click **Save** to save the Outdoor Area definition and its Campus location in the Cisco WCS database. Cisco WCS saves the Outdoor Area name in the Outdoor Area rectangle on the Campus map. Note that there will be a hyperlink associated with the Building Name or Outdoor Area.



- Repeat this section for any remaining Outdoor Areas.

When you have completed this section for all Outdoor Areas, continue with *Using the Cisco Wireless Control System*.

Adding Floor Plans to a Campus Building

After you have added a Building to a Campus as described in *Adding a Building to a Campus*, you can add individual floor plan and basement maps to the Building. Proceed with the following:

- If not already done, save your floor plan map(s) in .FPE, .PNG, .JPG, or .GIF format. They can be any size, as Cisco WCS automatically resizes the map(s) to fit in its working areas.

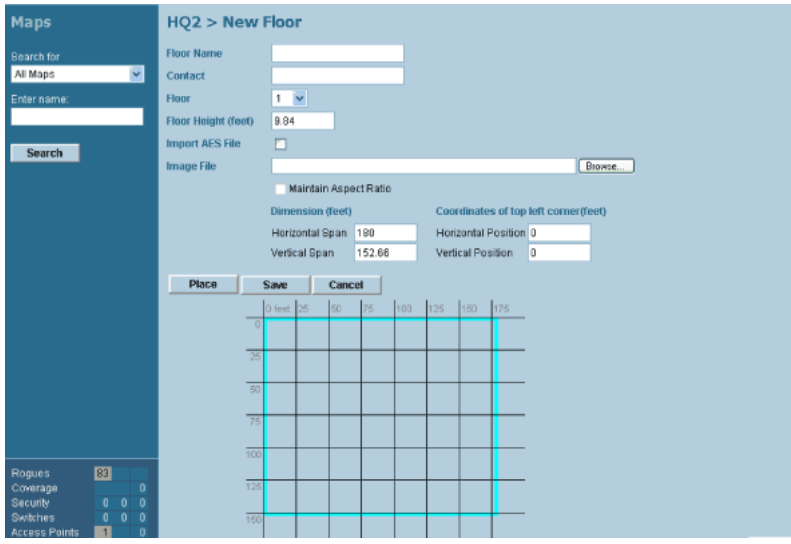
  Note: When you are importing a .FPE floor plan map, you will also need to import a corresponding .PNG, .JPG, or .GIF format floor plan map. Importing the .PNG, .JPG, or .GIF format floor plan map allows Cisco WCS to correctly display the floor plan, and importing the .FPE floor plan map allows Cisco WCS to properly adjust the RF signal strengths as modified by the walls and other RF obstructions.

- Browse to and import the map(s) from anywhere in your file system.
- Select the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- In the Maps Page, select the desired **Campus**.

  The Cisco WCS User Interface displays the **Maps > <Campus Name>** page.
- In the **Maps > <Campus Name>** page Button Area, move the cursor over an existing **Building** rectangle to highlight it. Note that when you highlight the **Building** rectangle, the **Building** description appears in the Sidebar area.

- Left-click on the **Building** rectangle to have Cisco WCS display the **Maps > <Campus Name> > <Building Name>** page.

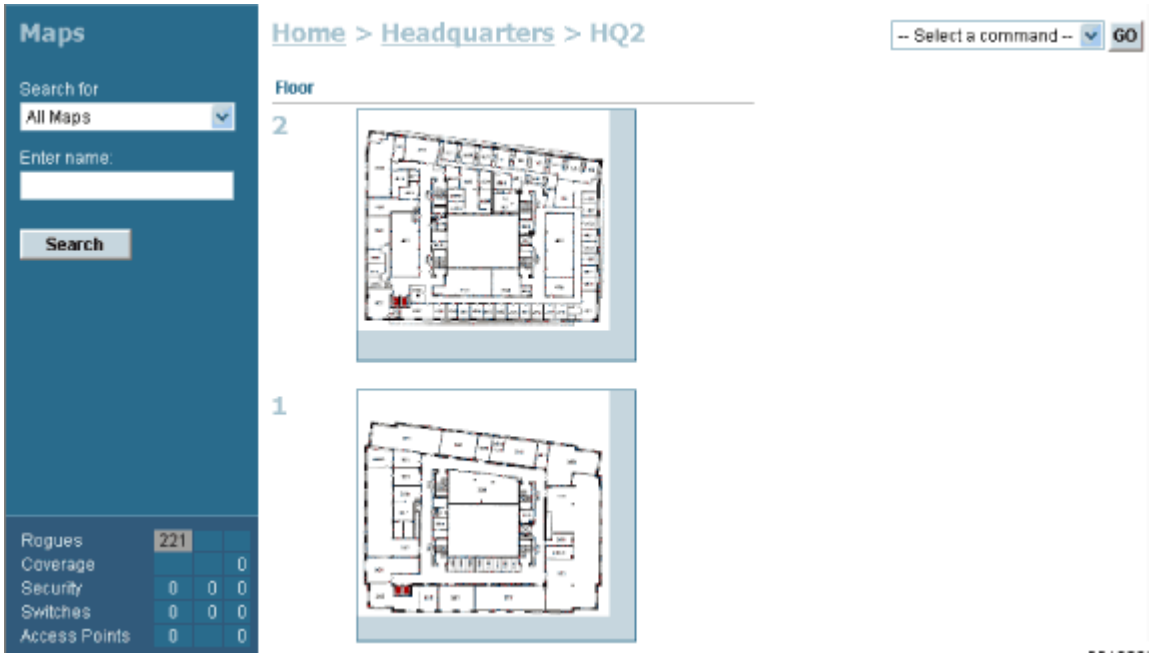
- From the **Select a command** drop-down menu, select **New Floor Area** and click **GO** to have the Cisco WCS User Interface display the **<Building Name> > New Floor** page.



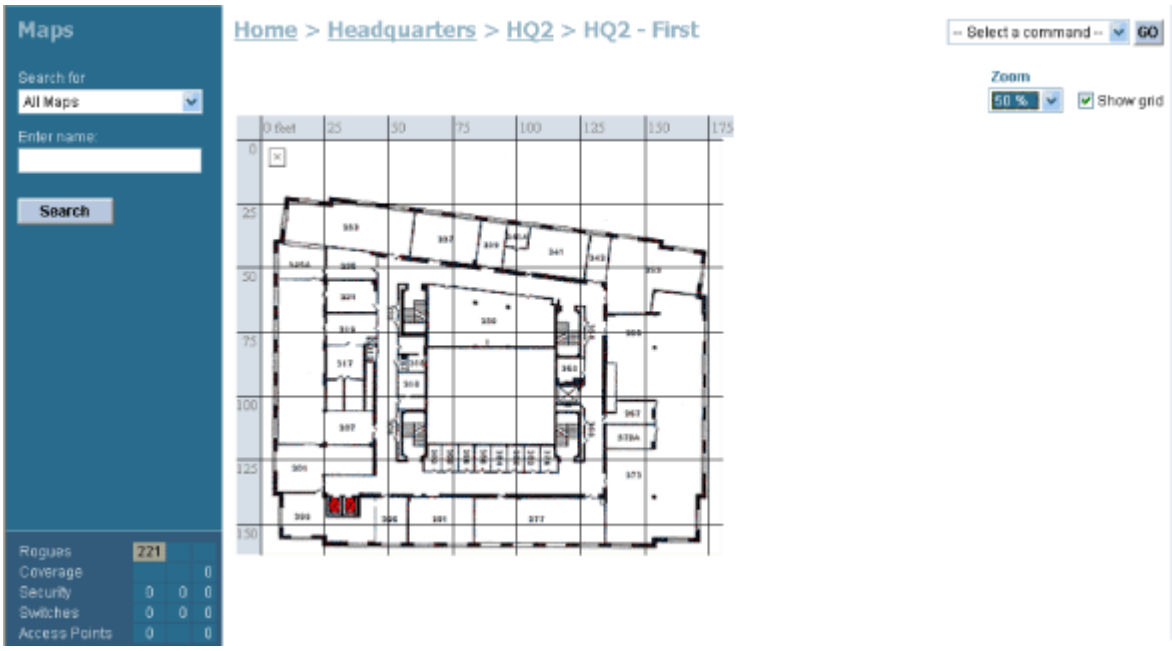
- In the **<Building Name> > New Floor** page, you can add floors to a Building to organize related Floor Plan maps. To do this:
  - Enter the Floor or Basement Name.
  - Enter the Floor or Basement Contact Name.
  - Select the Floor or Basement number.
  - Enter the Floor-to-Floor Height in feet.
  - Also, when you are importing a .FPE floor plan map file from the Floor Plan Editor, click **Browse** to search for and select the desired .FPE Floor or Basement graphic name.
  - In all cases, click **Browse** to search for and select the desired Floor or Basement graphic name. Note that when you select the Floor or Basement graphic, Cisco WCS displays the graphic in the Building-sized grid.
  - Enter an approximate Floor or Basement Horizontal Span and Vertical Span (width and depth on the map) in feet. Note that these numbers should be smaller than or the same as the Building Horizontal Span and Vertical Span in the Cisco WCS database.
  - If necessary, click **Place** to locate the Floor or Basement graphic on the Building grid.

  Note: You can use **<CTRL-Left-Click>** to resize the graphic within the Building-sized grid. Leave Maintain Aspect Ratio checked to preserve the original graphic aspect ratio, or uncheck the Maintain Aspect Ratio box to change the graphic aspect ratio. Once again, use <**CTRL-Left-Click>** to change the graphic aspect ratio.

- Click **Save** to save the Building definition to the Cisco WCS database. The Cisco WCS User Interface displays the floor plan graphic in the **Maps > <Campus Name> > <Building Name>** page.



- In the **Maps > <Campus Name> > <Building Name>** page, left-click any of the Floor or Basement images to view the floor plan or basement map as shown in the following figure. Note that you can zoom in and out to view the map at different sizes, and can add access points.



- Repeat this section for any remaining Floors or Basements.

Using Map Editor

Map Editor allows you to define, draw, and enhance floor plan related information. It allows you to create and specify the type of obstacles so that they can be taken into consideration while computing RF prediction heatmaps for access points. You can also add coverage areas for Location Appliances that locate clients and tags in that particular area.

To access the Map Editor:

- Highlight the **Monitor** tab and click **Maps** to bring up the **Maps** page.
- Click the desired campus under the **Name** list.
- Click on a building on the campus.
- Click on the desired floor area to bring up the **Maps** > <**Campus name**> > <**Building name**> > <**Floor area name**> page.
- From the **Select a command** drop-down menu, select Map Editor and click **GO** to bring up the Map Editor page.

For a detailed information, refer to Map Editor under Cisco WCS User Interface Online Help.

Continue with *Adding Floor Plans to a Standalone Building* or *Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Open Area Maps*.

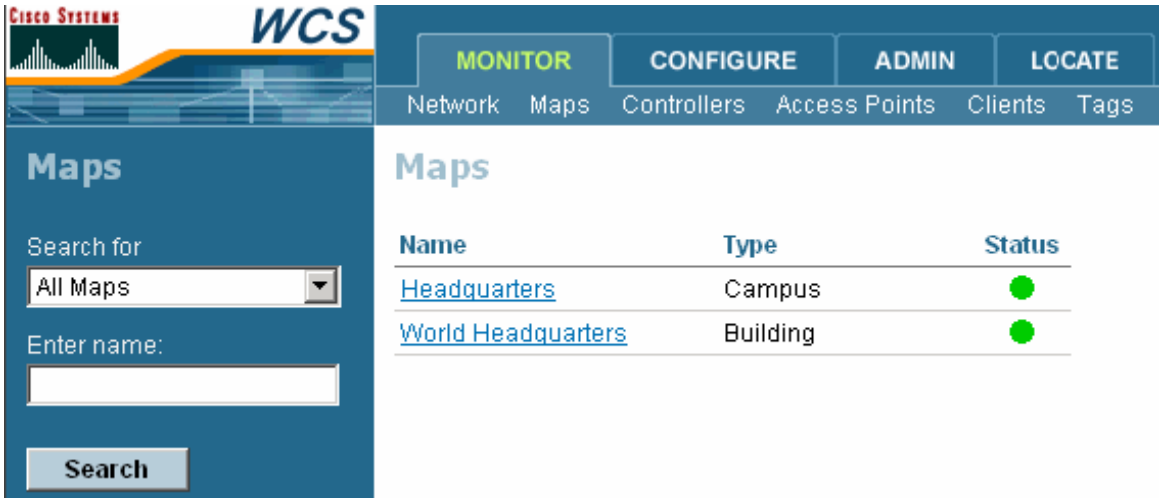
Adding Floor Plans to a Standalone Building

After you have added a standalone Building to the Cisco WCS database as described in *Adding a Standalone Building to the Cisco WCS Database*, you can add individual floor plan maps to the Building. Proceed with the following:

- If not already done, save your floor plan map(s) in .FPE, .PNG, .JPG, or .GIF format. They can be any size, as Cisco WCS automatically resizes the map(s) to fit in its working areas.

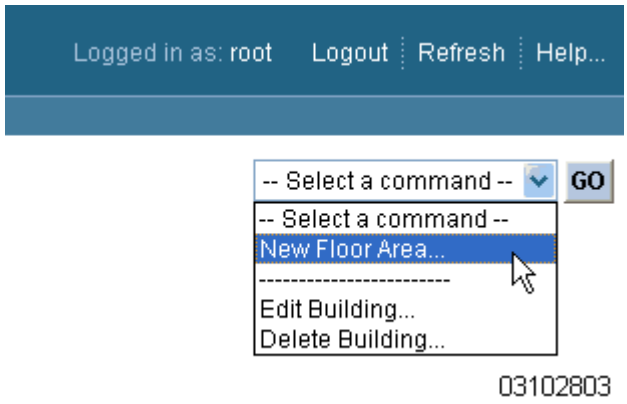
  Note: When you are importing a .FPE floor plan map, you will also need to import a corresponding .PNG, .JPG, or .GIF format floor plan map. Importing the .PNG, .JPG, or .GIF format floor plan map allows Cisco WCS to correctly display the floor plan, and importing the .FPE floor plan map allows Cisco WCS to properly adjust the RF signal strengths as modified by the walls and other RF obstructions.

- Browse to and import the map(s) from anywhere in your file system.
- Select the **Monitor** Tab.
- Click **Maps** to have Cisco WCS display the **Maps** page.
- In the Main Data Page, select the desired **Building**.

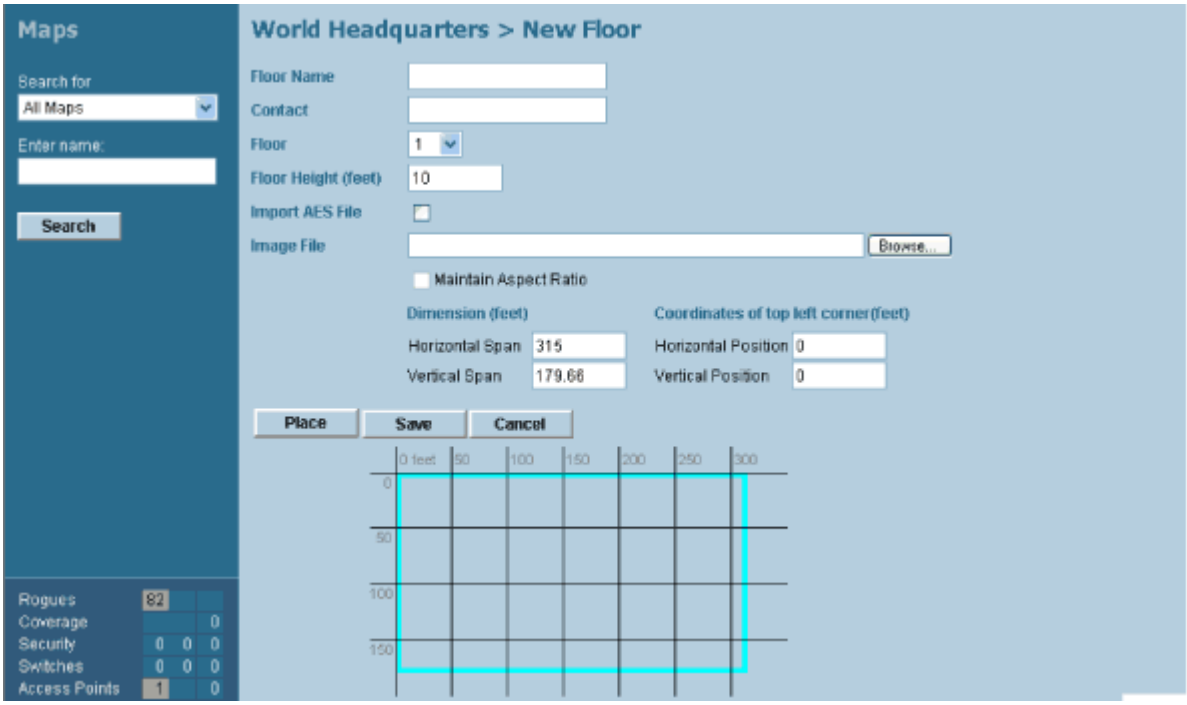


The Cisco WCS User Interface displays the **Maps > <Building Name>** page.

- From the **Select a command** drop-down menu, select **New Floor Area**.



- Click **GO** to have the Cisco WCS User Interface display the **<Building Name> > New Floor** page.

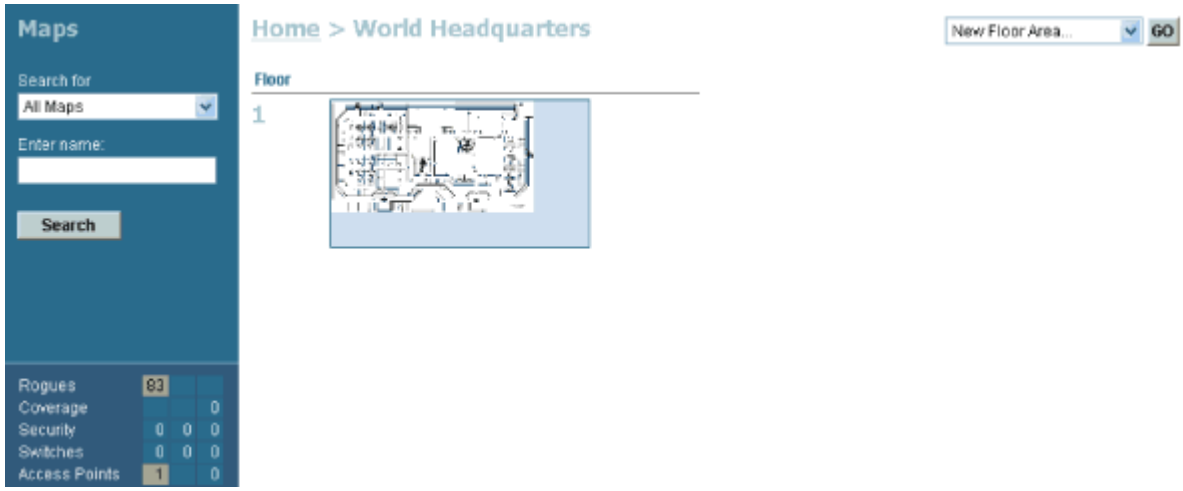


- In the **<Building Name> > New Floor** page, you can add floors to a Building to organize related Floor Plan maps. To do this:
  - Enter the Floor or Basement Name.
  - Enter the Floor or Basement Contact Name.
  - Select the Floor or Basement number.
  - Enter the Floor-to-Floor Height in feet.
  - When you are importing a .FPE floor plan map file from the Floor Plan Editor, check the Import FPE File box. Otherwise, leave this box unchecked.

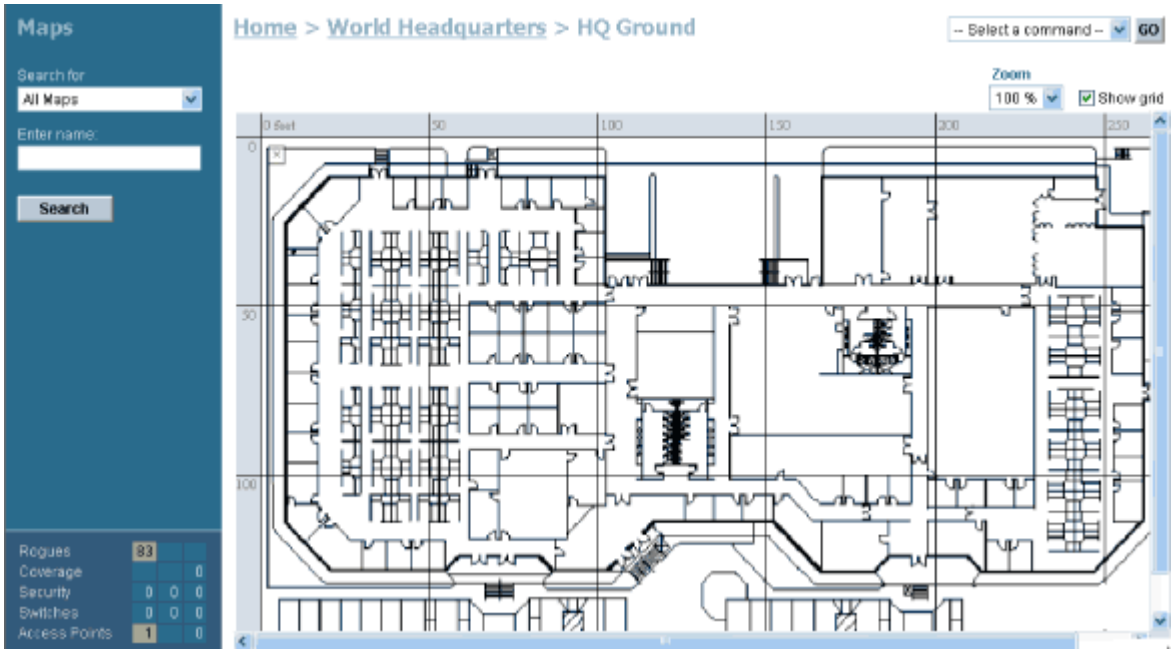
    Also, when you are importing a .FPE floor plan map file from the Floor Plan Editor, click **Browse** to search for and select the .FPE desired Floor or Basement graphic name.
  - In all cases, click **Browse** to search for and select the desired Floor or Basement graphic name. Note that when you select the Floor or Basement graphic, Cisco WCS displays the graphic in the Building-sized grid.
  - Enter an approximate Floor or Basement Horizontal Span and Vertical Span (width and depth on the map) in feet. Note that these numbers should be smaller than or the same as the Building Horizontal Span and Vertical Span in the Cisco WCS database.
  - If necessary, click **Place** to locate the Floor or Basement graphic on the Building grid.

  Note: You can use **<CTRL-Left-Click>** to resize the graphic within the Building-sized grid. Leave Maintain Aspect Ratio checked to preserve the original graphic aspect ratio, or uncheck the Maintain Aspect Ratio box to change the graphic aspect ratio. Once again, use **<CTRL-Left-Click>** to change the graphic aspect ratio.

  - Click **Save** to save the Building definition to the Cisco WCS database. The Cisco WCS User Interface displays the floor plan graphic in the **Maps > <Building Name>** page.



- In the **Maps > <Building Name>** page, left-click any of the Floor or Basement images to view the floor plan or basement map as shown in the following figure. Note that you can zoom in and out to view the map at different sizes, and can add access points from this page.



- Repeat this section for any remaining Floors or Basements.

Continue with *Adding Floor Plans to a Campus Building* or *Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Open Area Maps*.

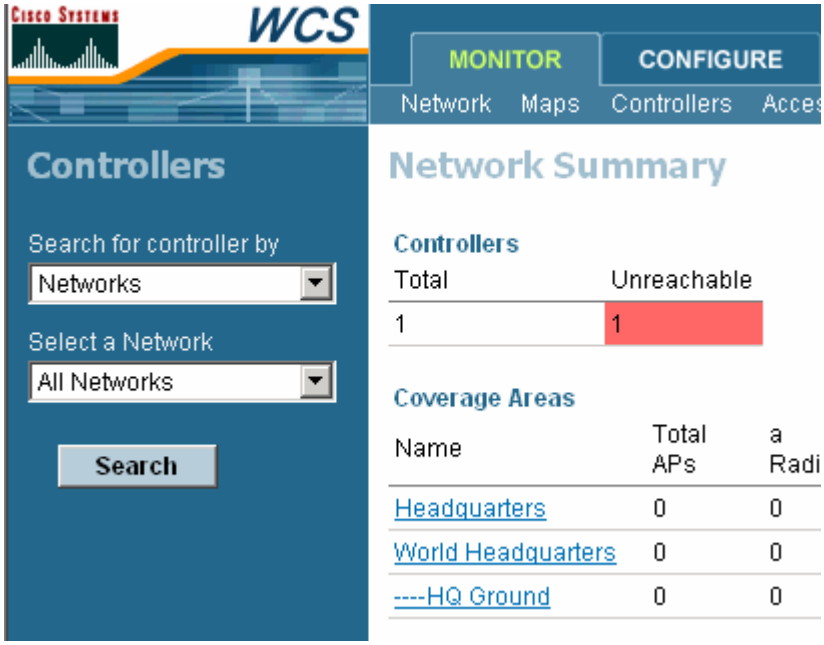
Adding Cisco 1000 Series Lightweight Access Points to Floor Plan and Outdoor Area Maps

This procedure assumes that you have added the Floor Plan and/or Outdoor Area maps as described in *Adding Floor Plans to a Campus Building*, *Adding Floor Plans to a Standalone Building* and *Adding an Outdoor Area to a Campus*. This procedure also assumes that you have added Cisco Wireless LAN Controllers to the Cisco WCS database as described in *Adding a Cisco Wireless LAN Controller to Cisco WCS* before continuing.

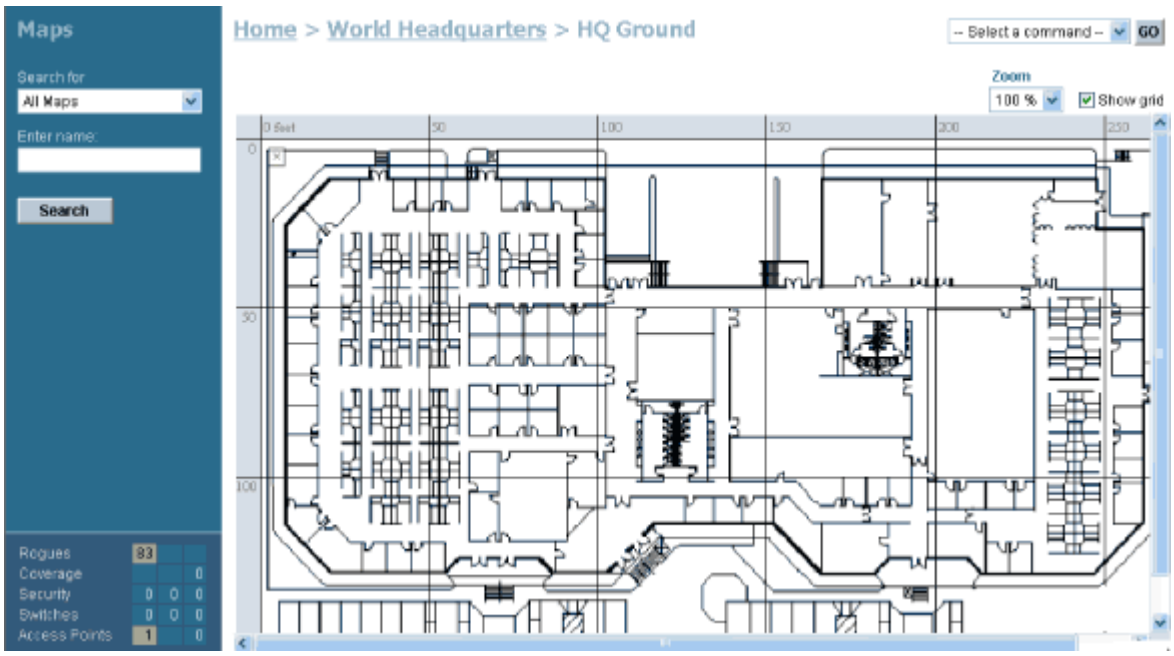
After you have added the .FPE and/or .PNG, .JPG, or .GIF format Floor Plan and Outdoor Area (Coverage Area) maps and Cisco Wireless LAN Controllers to the Cisco WCS database, you can position Cisco 1000 Series lightweight access point icons on the Cisco WCS maps to show where they are installed in the Buildings.

Add access points to the Coverage Area maps as follows:

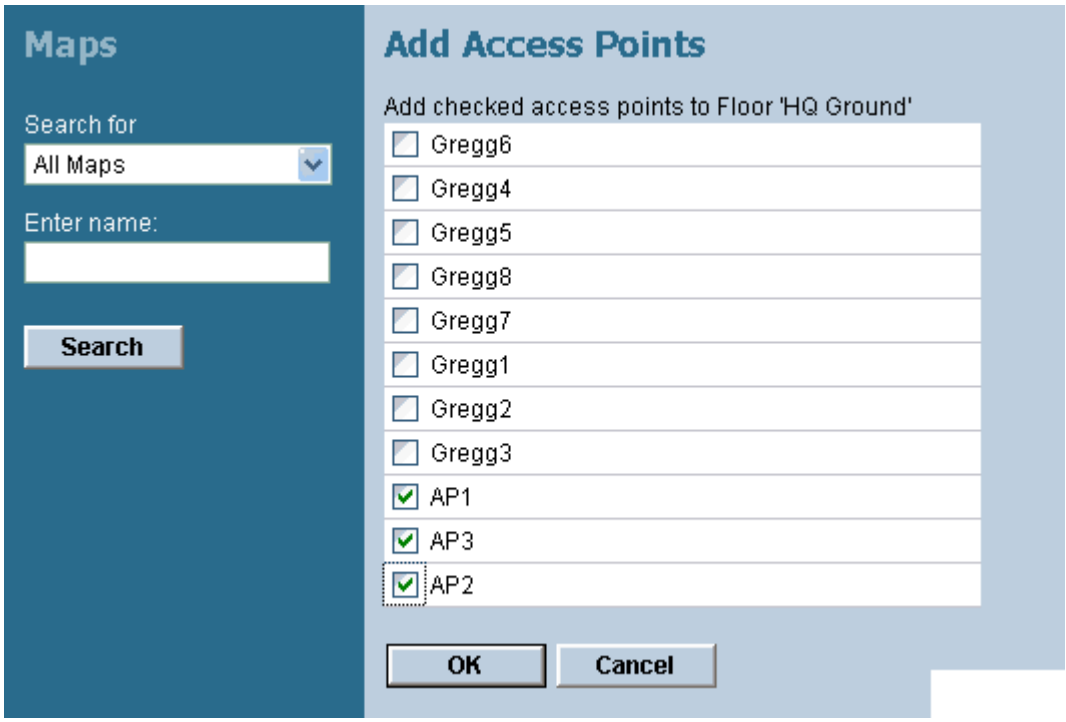
- Select the **Monitor** Tab.
- Click **Network** to have Cisco WCS display the **Network Summary** page.
- In the **Network Summary** page, click the desired Floor Plan or Outdoor Area map.



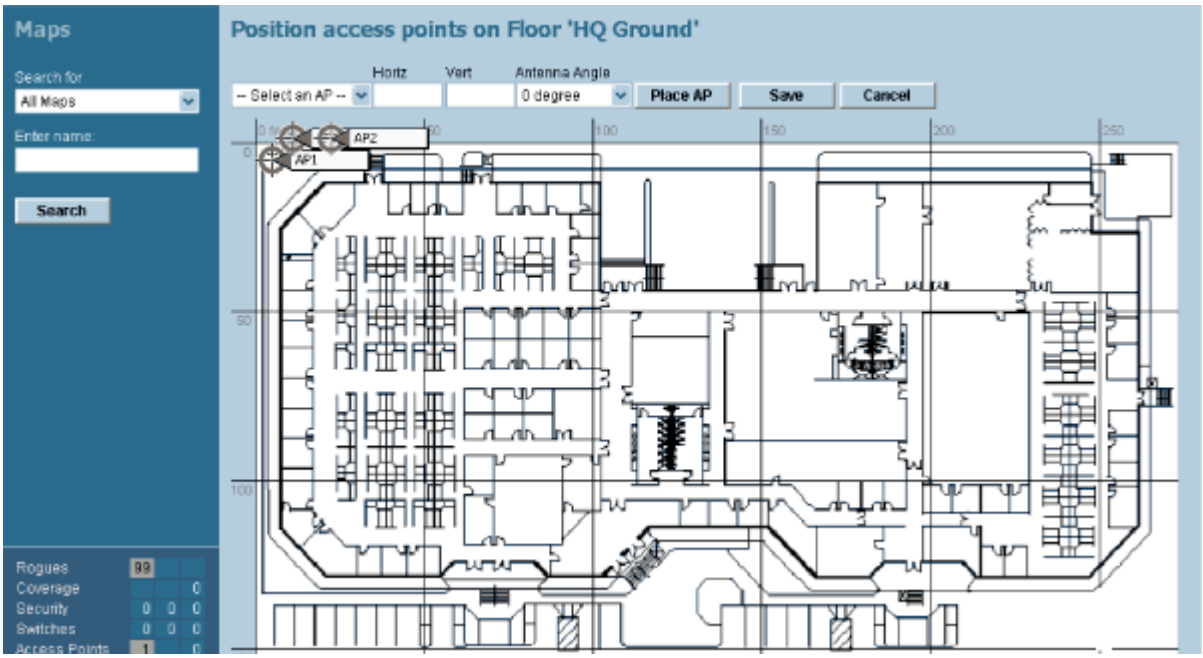
Cisco WCS displays the associated Coverage Area Map similar to the following:



- From the Select a command drop-down menu, select **Add Access Points** and click **GO** to have the Cisco WCS User Interface display the **Add Access Points** page.
- In the **Add Access Points** page, check the Cisco 1000 Series lightweight access points to add to the map.



- Click **OK** to have the Cisco WCS User Interface add the Cisco 1000 Series lightweight access points to the map and display the **Position Access Points** map similar to the following:



Note that the Cisco 1000 Series lightweight access point icons appear in the upper left area of the map.

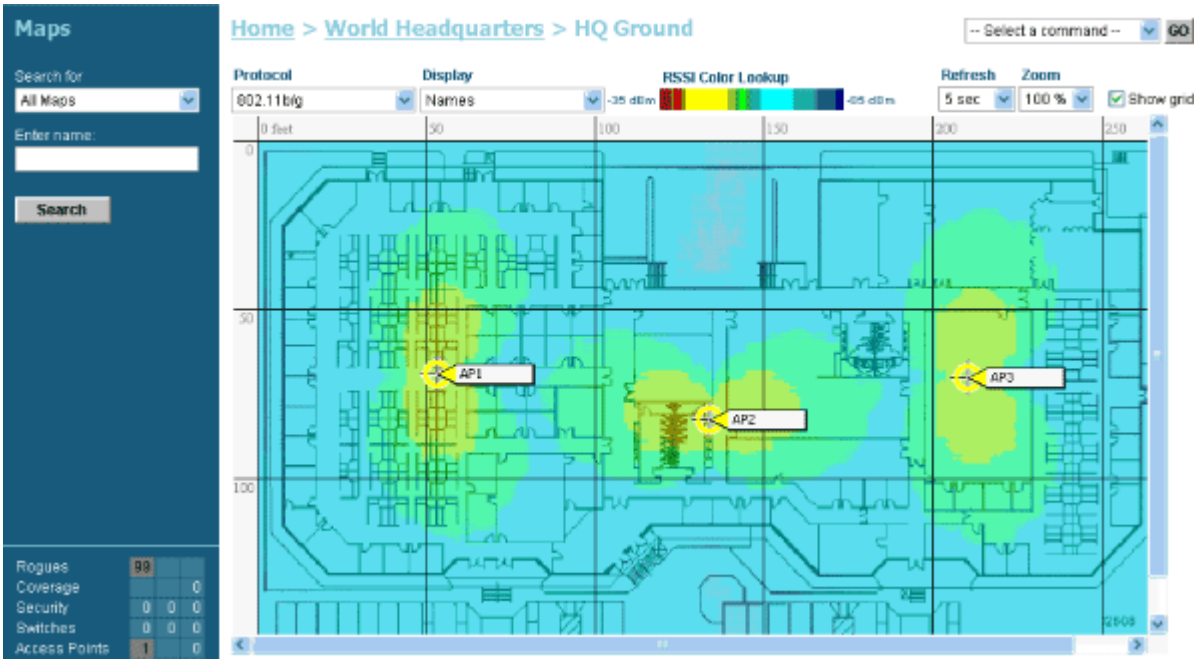
- Left-click and drag the Cisco 1000 Series lightweight access point icons to indicate their physical locations.
- Highlight each Cisco 1000 Series lightweight access point icon in turn, and select the Antenna Angle.

  Note: The Antenna Angle is relative to the Map “X” axis. Because the origin of the “X” and “Y” axes is at the upper left hand corner of the Map, 0 degrees points Side A of the Cisco 1000 Series lightweight access point to the right, 90 degrees points Side A down, 180 degrees points Side A to the left, and so on.

  Note: In the following example, AP1 and AP3 are set to 90 degrees, and AP2 is set to 0 degrees, so the three Cisco 1000 Series lightweight access points provide maximum coverage for the inside of the building and not the loading dock.

  Also note that the first display is only an approximation of the actual RF signal intensity, because it does not take into account the attenuation of various building materials, such as drywall or metal objects, nor does it display the effects of RF signals bouncing off obstructions.

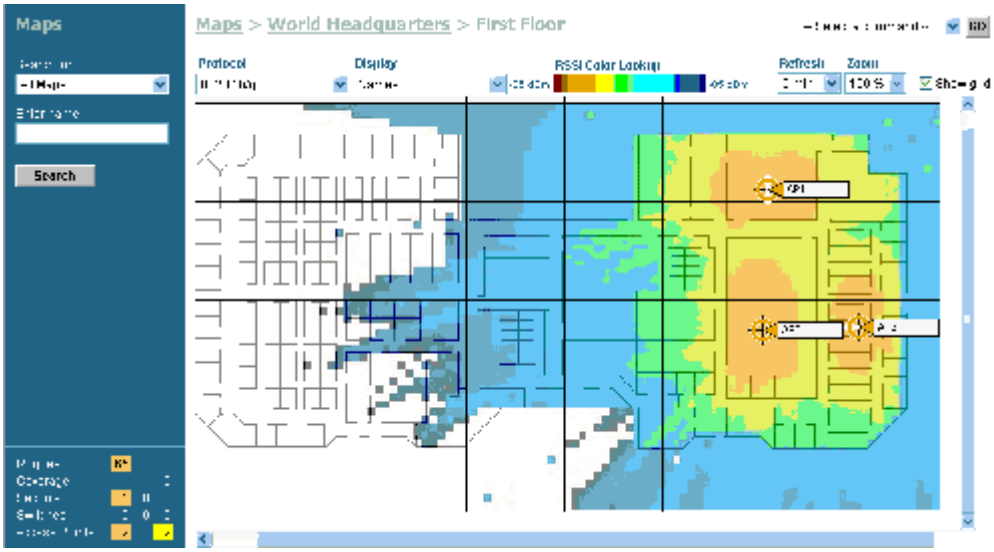
- When you have imported a .PNG, .JPG, or .GIF format Coverage Area map, click **Save** to store the Cisco 1000 Series lightweight access point locations and orientations, and have Cisco WCS compute the first-order RF prediction (or “Heat Map”) for the Coverage Area.



- When you have imported a .FPE and a .PNG, .JPG, or .GIF format Coverage Area map, click **Save** to store the Cisco 1000 Series lightweight access point locations and orientations, and have Cisco WCS compute the second-order RF prediction (or “Heat Map”) for the Coverage Area.

  ▶ **Note:** In the following example, AP1 is set to 0 degrees, and AP2 and AP3 are set to 90 degrees, so the three Cisco 1000 Series lightweight access points provide maximum coverage for the right wing of the building.

  ▶ **Note:** Also note that in the following example, each Cisco 1000 Series lightweight access point covers a much smaller area, because of the wall attenuation factored in by the RF Prediction algorithm.



  ▶ **Note:** These two displays are popularly known as “heat maps”, because they show the relative intensity of the RF signals on the Coverage Area map.

  ▶ **Note:** MAKE SURE you have the correct Cisco 1000 Series lightweight access point in each location on the map with the correct antenna angle. This will become critical later on when you are *Finding Coverage Holes* and *Detecting and Locating Rogue Access Points*.

- Repeat this section to assign Cisco 1000 Series lightweight access points to the remaining floor plan maps.

You have added Cisco 1000 Series lightweight access points to floor plan maps. Continue with *Using the Cisco Wireless Control System*.

Monitoring Predicted Coverage (RSSI)

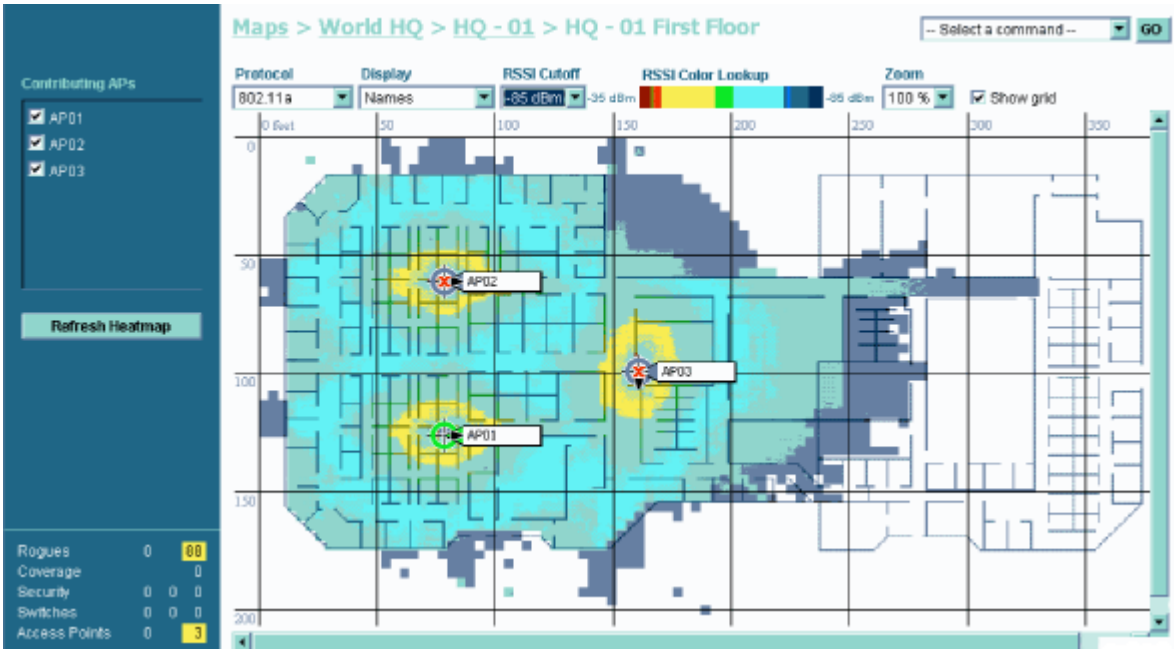
Use **MONITOR / Maps**, click an item in the **Name** column, left-click the floor map, from the Protocol drop-down menu, select a protocol to access this page.

This page assumes that you have already added active access points to the selected map.

The display of predicted RF coverage on the map is determined by the selection you make from the Protocol pulldown:

- For 802.11a and 802.11b/g: This information is displayed in the panel next to the Cisco 1000 Series lightweight access point icon as follows: n% Failed (a+b), where n is the percentage of Cisco Radios that failed.
- For 802.11a: A colored overlay appears on the map displaying the coverage patterns for the 802.11a Cisco Radios. A Received Signal Strength Indicator (RSSI) Color Lookup appears at the top of the map indicating the meaning of the colors. The colors show the signal strength form RED (-35 dBm) through DARK BLUE (-85 dBm). Next to each Cisco 1000 Series lightweight access point is a percentage of failure.
- For 802.11b/g: A colored overlay appears on the map displaying the coverage patterns for the 802.11b/g Cisco Radios. Received Signal Strength Indicator (RSSI) Color Lookup appears at the top of the map indicating the meaning of the colors. The colors show the signal strength form RED (-35 dBm) through DARK BLUE (-85 dBm). Next to each Cisco 1000 Series lightweight access point is a percentage of failure.

A sample RF Prediction Heat Map with Cisco 1000 Series lightweight access points providing coverage at one end of a building appears in the following figure:



Refer to *Adding Cisco 1000 Series Lightweight Access Points to a Cisco Wireless LAN Controller*.

Monitoring Channels on a Floor Map

Use **MONITOR / Maps**, click an item in the **Name** column, double-click the floor map, from the Display drop-down menu, select **Channel** to access this page.

When you select this option, the channel number being used by the Cisco Radio is displayed on the panel next to each Cisco 1000 Series lightweight access point. This display depends upon the selection made from the Protocol pulldown as follows:

- 802.11a: The display shows the channel: Ch#n, where n is the channel number.
- 802.11b/g: The display shows the channel: Ch#n, where n is the channel number.
- 802.11a and 802.11b/g: The display shows the channels in the following format: Ch#n/x, where n represents the channel being used by the 802.11a Cisco Radio and x represents the channel being used by the 802.11b/g Cisco Radio.

Monitoring Transmit Power Levels on a Floor Map

Use **MONITOR / Maps**, click an item in the **Name** column, double-click the floor map, from the Display drop-down menu, select **Tx Power Level** to access this page.

When you select this option, the power level number being used by the Cisco Radio is displayed on the panel next to each Cisco 1000 Series lightweight access point.

Power Level (1, highest through 5, lowest) Cisco 1000 Series lightweight access point transmit power level are as follows:

- 1 = Maximum power allowed per Country Code setting
- 2 = 50% power
- 3 = 25% power
- 4 = 6.25 to 12.5% power
- 5 = 0.195 to 6.25% power

The power levels and available channels are defined by the Country Code setting and are regulated on a country by country basis. Refer to *Cisco WLAN Solution Supported Country Codes* for the maximum Transmit Power Levels for each country.

Monitoring Coverage Holes on a Floor Map

Use **MONITOR / Maps**, click an item in the **Name** column, left-click the floor map, from the Display drop-down menu, select **Coverage Holes** to access this page.

In the Alarm Monitor, click on a colored Coverage alarm to access this page.

Coverage holes are areas where clients cannot receive a signal from the wireless network. When deploying wireless networks, there is a trade-off between the cost of the initial network deployment and the percentage of coverage hole areas. A reasonable coverage hole criterion for launch is between 2 and 10 percent. This means that between two and ten test locations out of 100 random test locations may receive marginal service. After launch, the Cisco WLAN Solution Radio Resource Management (RRM) identifies these coverage areas and reports them to the IT manager, allowing the IT manager to fill holes based on user demand. This percentage is shown in the panel next to each Cisco 1000 Series lightweight access point on the map. They are displayed as follows:

- 802.11a: The display shows the coverage hole percentage for this Cisco Radio.
- 802.11b/g: The display shows the coverage hole percentage for this Cisco Radio.
- 802.11a and 802.11b/g: The display shows the total coverage hole percentage for both Cisco Radios.

Monitoring Users on a Floor Map

Use **MONITOR / Maps**, click an item in the **Name** column, single-click the floor map, from the Display drop-down menu, select **Users** to access this page.

When you select this option, the number of clients being used by the Cisco Radio is displayed on the panel next to each Cisco 1000 Series lightweight access point. This display depends upon the selection made from the Protocol pulldown as follows:

- 802.11a: The display shows the number of clients using this protocol in the form n clients, where n is the number of clients. Click “n clients” to display a list of clients. Refer to *Monitoring Clients on a Floor Map*.
- 802.11b/g: The display shows the number of clients using this protocol. Click “n clients” to display a list of clients. Refer to *Monitoring Clients on a Floor Map*.
- 802.11a and 802.11b/g: The display shows the total number of clients using a combination of both protocols. Click “n clients” to display a list of clients. Refer to *Monitoring Clients on a Floor Map*.

Monitoring Clients on a Floor Map

Use **MONITOR / Maps**, click an item in the **Name** column, double-click the floor map, from the Display drop-down menu, select **Users**, click **n clients** to access this page.

This page displays client parameters.

Table - Clients

Parameter	Description
Check Box	Click to select, so that a command can be applied.
User Name	Name of the user. Refer to Monitor Client <client name> in the Cisco WCS User Interface Online Help.
IP Address	IP Address of the client.
MAC Address	MAC address of the client.
Access Point	Access Point Name. Refer to Monitor Access Points <name> in the Cisco WCS User Interface Online Help.
Controller	IP Address of Cisco Wireless LAN Controller to which this Cisco 1000 Series lightweight access point is attached. Refer to Monitor Switches <IPaddress> Summary in the Cisco WCS User Interface Online Help.
Port	Port number of the Cisco Wireless LAN Controller to which this Cisco 1000 Series lightweight access point is attached.
Status	Associated or non-associated.
SSID	Service Set Identifier being broadcast by the Cisco Radio.
Auth	Authentication enabled. Yes or No.
Protocol	802.11a or 802.11b/g.

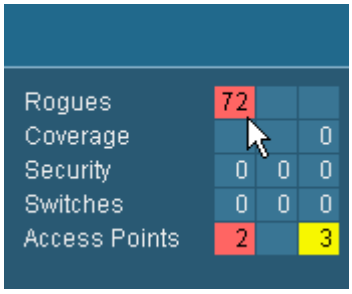
Troubleshooting with Cisco WCS

- *Checking the Cisco WLAN Solution Network Summary*
- *Detecting and Locating Rogue Access Points*
- *Acknowledging Rogue Access Points*
- *Locating Clients*
- *Finding Coverage Holes*
- *Pinging a Network Device from a Cisco Wireless LAN Controller*
- *Viewing Current Cisco Wireless LAN Controller Status and Configurations*
- *Viewing Cisco WCS Statistics Reports*
- *Checking the Cisco WLAN Solution Network Summary*
- *Viewing Current Cisco Wireless LAN Controller Status and Configurations*
- *Viewing Cisco WCS Statistics Reports*

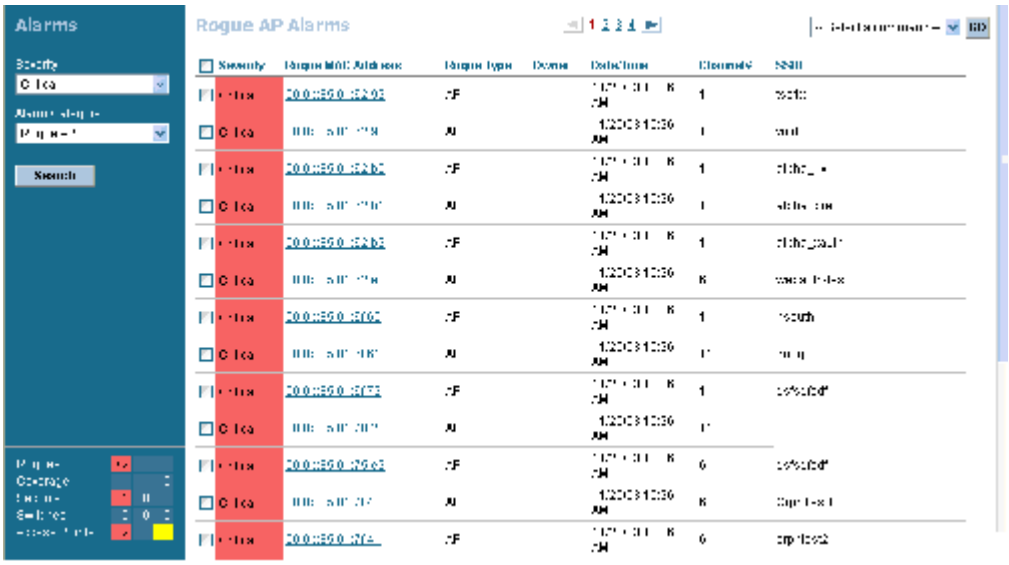
Detecting and Locating Rogue Access Points

When the Cisco 1000 Series Lightweight Access Points are powered up and associated with Cisco Wireless LAN Controllers, the Cisco Wireless Control System built into the Operating System immediately starts listening for Rogue Access Points. When a Cisco Wireless LAN Controller detects a rogue access point, it immediately notifies Cisco WCS, which creates a rogue access point alarm.

When Cisco WCS receives a rogue access point message from a Cisco Wireless LAN Controller, Cisco WCS generates an alarm, with an indicator visible in the lower left corner of all Cisco WCS User Interface pages. Notice that the following example shows 72 Cisco WCS rogue access point alarms.

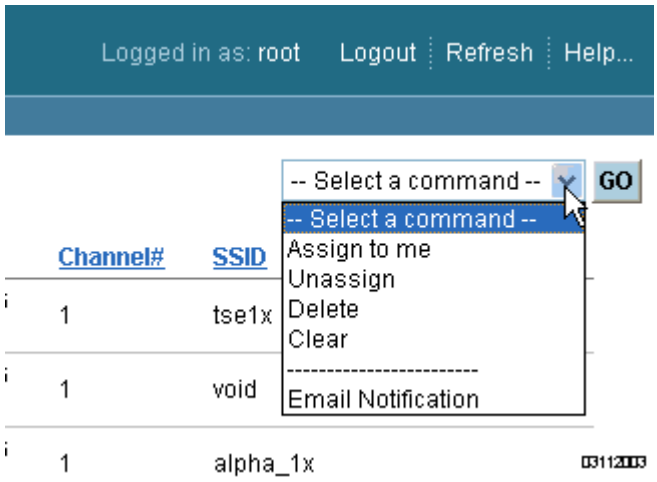


- To see more detail on the rogue access points, click the **Rogues** indicator to display the **Rogue AP Alarms** page.

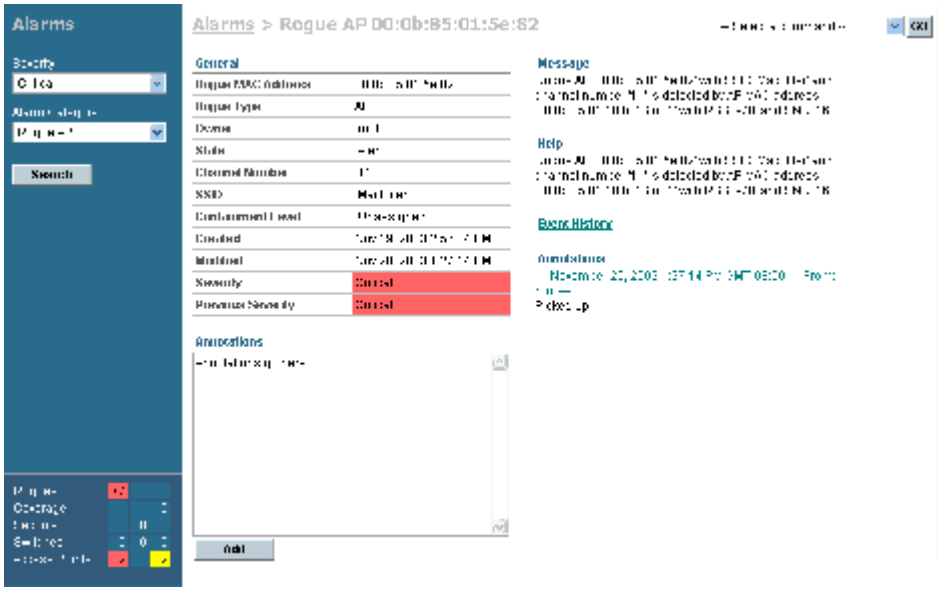


In the **Rogue AP Alarms** page, you can see the severity of the alarms, the rogue access point MAC addresses, the rogue access point types, the owners (Cisco WCS operators), the date and time when the rogue access points were first detected, the channel numbers they are broadcasting on, and their SSIDs.

Also in this page, you can highlight one or more entries by checking the desired check boxes, and then allows you to apply the following commands to all selected rogue access point alarms: **Assign to me**, **Unassign**, **Delete**, **Clear**, or configure **Email Notification**.

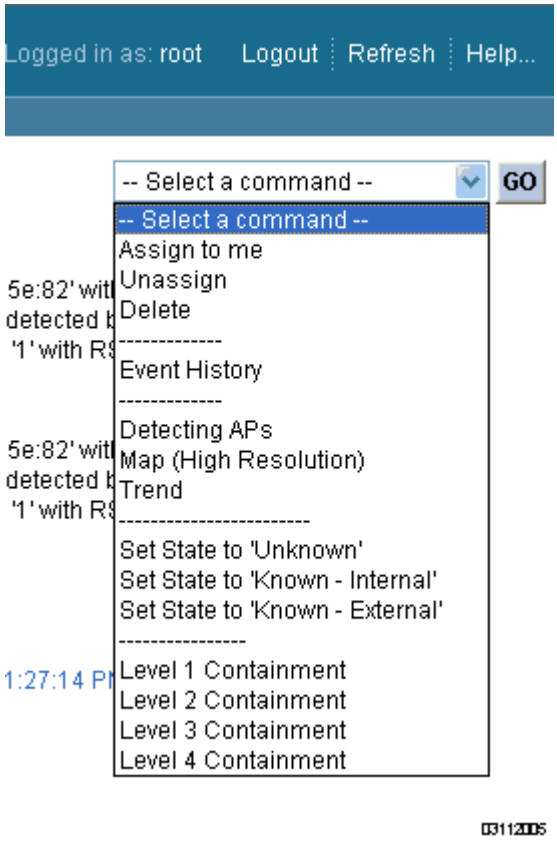


- To see more rogue access point information, click any **Rogue MAC Address** link to have Cisco WCS display the associated **Alarms > Rogue AP <MAC address>** page.

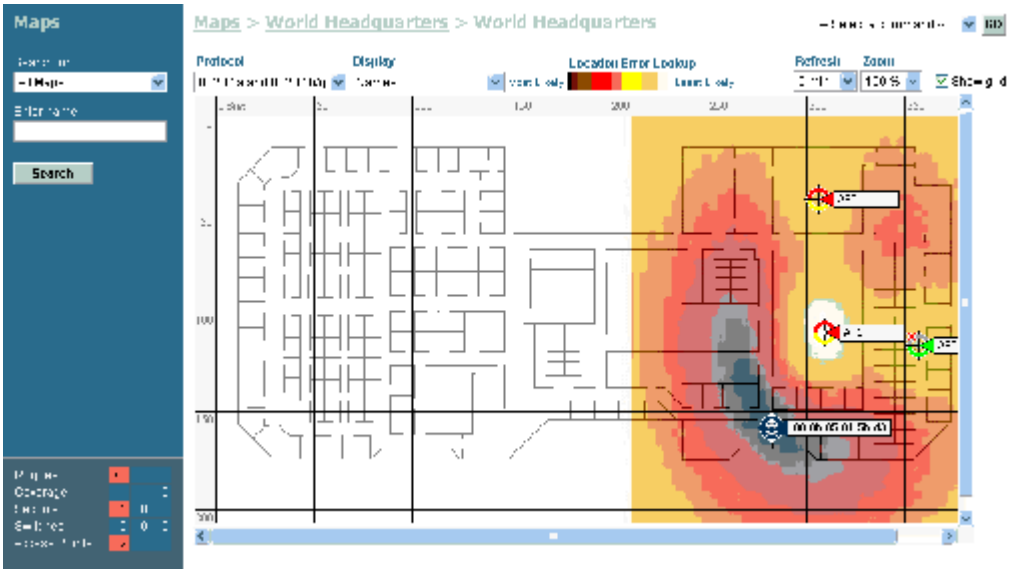


The **Alarms > Rogue AP <MAC address>** page shows detailed information about the rogue access point alarm, and allows you to modify the rogue access point alarm with the following commands:

- **Assign to me**.
- **Unassign**.
- **Delete**.
- Show the **Event History**.
- Display the **Detecting APs** (with Radio Band, Location, SSID, Channel Number, WEP state, short or long preamble, RSSI and SNR).
- Show a high-resolution **Map** with the current calculated location, or a low-resolution **Map** with the rogue access point located at the Cisco 1000 Series lightweight access point that detects strongest RSSI transmissions.
- Show a **Trend** of recent RSSI signal strength.
- Set the State to **Unknown**, **Known-Internal**, or **Known-External** (as described in *Rogue Access Point Location, Tagging and Containment*).
- Set up **Level 1** through **Level 4 Containment** (as described in *Rogue Access Point Location, Tagging and Containment*).



- In the **Alarms > Rogue AP <MAC address>** page, select **Map** to have Cisco WCS display the current calculated rogue access point location on the **Maps > <building name> > <floor name>** page.



Note that Cisco WCS Location compares RSSI signal strength from two or more Cisco 1000 Series lightweight access points to find the most probable location of the rogue access point, and places a small “skull-and-crossbones” indicator at its most likely location.

Note that Cisco WCS Base function compares RSSI signal strength from the rogue access point, and places a small “skull-and-crossbones” indicator next to the Cisco 1000 Series lightweight access point receiving the strongest RSSI signal from the rogue access point.

▶ **Note:** When the rogue access point does not receive a packet from the rogue access point client, Cisco WCS cannot reliably determine the rogue access point client location.

▶ **Note:** When the rogue access point does not receive a packet from the rogue access point client, Cisco WCS cannot reliably determine the rogue access point client location.

Acknowledging Rogue Access Points

- To acknowledge known rogue access points, navigate to the **Rogue AP Alarms** page. Right-click the rogue access point (red, unknown) to be acknowledged, and select **Set State to ‘Known Internal’** or **Set State to ‘Known External’**. In either case, the red rogue access point entry is removed from the **Alarms** Page.

Locating Clients

The Cisco WCS allows system operators to locate clients in the enterprise. Do the following:

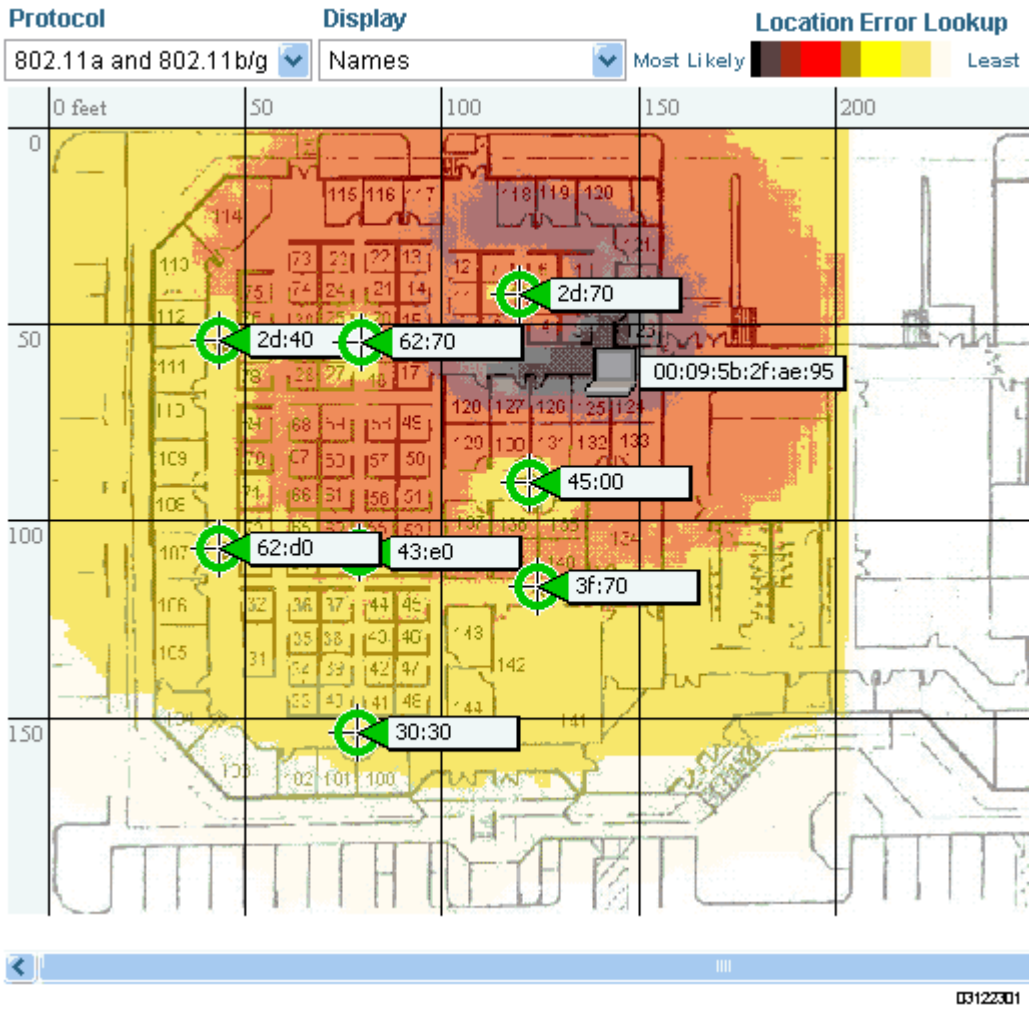
- Use **Monitor / Clients** to navigate to the **Clients Summary** page.
- On the **Clients Summary** page, in the left sidebar **Search** for **All Clients** to have Cisco WCS display the **Clients** page.

- From the **Clients** page, click the **User Name** of the client you want to locate. Cisco WCS displays the corresponding **Clients <client name>** page.
- From the **Clients <client name>** page, you have two choices for locating the client:
  - In the drop-down menu, select **Recent Map (high/low resolution)** to locate the client without dissociating it.
  - In the drop-down menu, select **Present Map (high/low resolution)** to dissociate and then locate the client after reassociation. If you make this choice, Cisco WCS displays a warning message and asks you to confirm that you want to continue.

  Note that Cisco WCS Location compares RSSI signal strength from two or more Cisco 1000 Series lightweight access points to find the most probable location of the client, and places a small “Laptop” icon at its most likely location.

  Note that Cisco WCS Base compares RSSI signal strength from the client, and places a small “Laptop” icon next to the Cisco 1000 Series lightweight access point receiving the strongest RSSI signal from the client.

Refer to the following illustration for a Heat Map showing client locations.



Finding Coverage Holes

Coverage holes are areas where clients cannot receive a signal from the wireless network. The Operating System Radio Resource Management (RRM) identifies these coverage hole areas and reports them to Cisco WCS, allowing the IT manager to fill holes based on user demand.

When Cisco WCS displays the Top 5 Coverage Holes, click the **Coverage** indicator on the bottom left of the Cisco WCS User Interface page (or click MONITOR/Alarms and then search for Alarm Category Coverage) to have Cisco WCS display the **Coverage Hole Alarms** page. On the **Coverage Hole Alarms** page, click MONITOR/Maps and then search for **Access Points** by **Cisco 1000 Series lightweight access point Name** (this search tool is case-sensitive). Cisco WCS displays the **Maps > Search Results** page, which lists the Floor or Outdoor Area where the Cisco 1000 Series lightweight access point is located. Click the link to display the related **Maps > <building name> > <floor name>** page.

On the **Maps > <building name> > <floor name>** page, look for areas of low signal strength near the Cisco 1000 Series lightweight access point that reported the coverage hole. Those are the most likely locations of coverage holes. If there do not appear to be any areas of weak signal strength, make sure that the floor plan map is accurate, and if you have used the Floor Plan Editor to create .FPE files, that you have not left out any metal obstructions, such as walls, elevator shafts, stairwells, or book-cases. If so, add them to the .FPE floor plan file and replace the old floor plan with the new floor plan.

Pinging a Network Device from a Cisco Wireless LAN Controller

To ping other devices from Cisco Wireless LAN Controller:

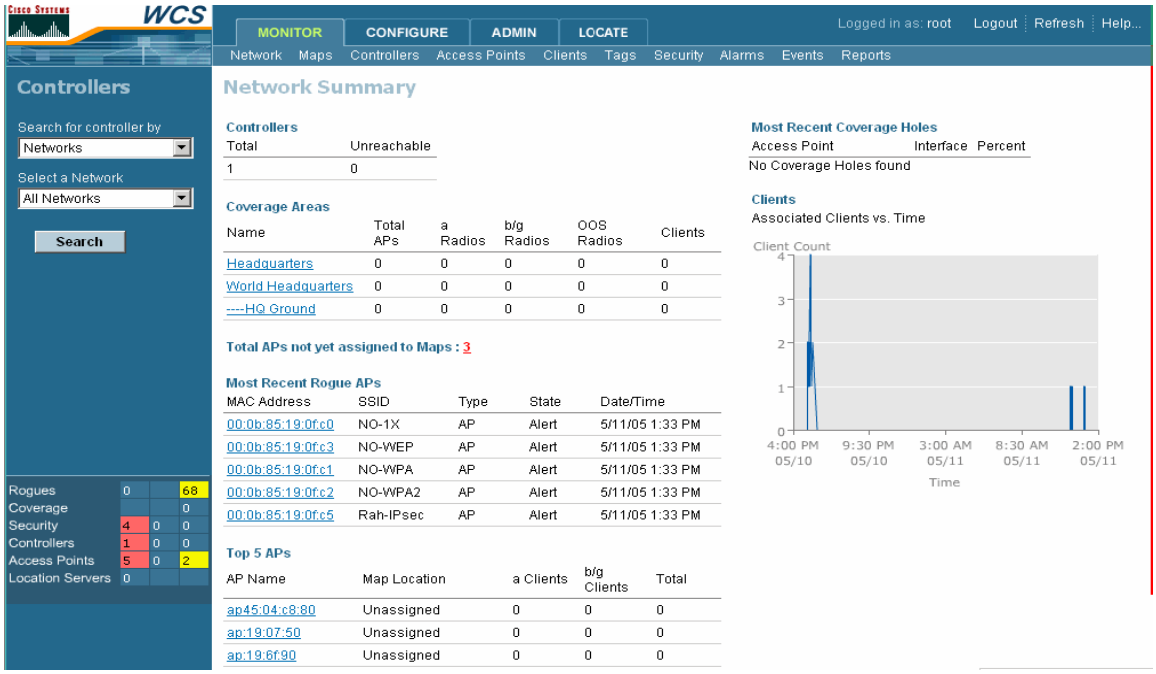
- Use **CONFIGURE/Controllers** and click an IP address under the IP Address column to have Cisco WCS display the **<IPaddress> > Controller Properties** page.
- On the **<IPaddress> > Controller Properties** page, in the left sidebar select **System/Commands** to have Cisco WCS display the **<IPaddress> > Controller Commands** page.
- On the **<IPaddress> > Controller Commands** page, select **Administrative Commands/Ping from Switch** and click **GO**.
- In the **Enter an IP Address (x.x.x.x) to Ping** window, enter the IP address of the network device that the Cisco Wireless LAN Controller is to ping, and click **OK**.
- Cisco WCS displays the **Ping Results** window showing the packets sent and received. Click **Restart** to ping the network device again, or click **Close** to stop pinging the network device and close the Ping Results window.

Viewing Current Cisco Wireless LAN Controller Status and Configurations

After you have added Cisco Wireless LAN Controllers and Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Points to the Cisco WCS database as described in *Using Cisco WCS*, you can view the Cisco WLAN Solution status as follows:

- In the Cisco WCS User Interface, click MONITOR/Network to display the Monitor Network Summary. Refer to the following figure for more information.

Figure - Typical Network Summary Page



Viewing Cisco WCS Statistics Reports

Cisco WCS periodically collects statistics, such as RSSI, SNR, profile failures, client counts, rogue access point trend, and busy clients, and organizes them into reports. To view these reports, use the MONITOR/Reports screens.

Updating OS Software from Cisco WCS

When you plan to update Cisco Wireless LAN Controllers (and Cisco 1000 Series lightweight access point) Operating System software from Cisco WCS, complete the following.

> **Note:** For the Cisco 2000 Series Wireless LAN Controller, the Cisco WCS Server MUST be on the same subnet as the Cisco 2000 Series Wireless LAN Controller management interface because this Cisco Wireless LAN Controller does not have a service port.

- Use the **`ping <IP Address>`** command in a Command Prompt window to ensure that Cisco WCS Server can contact the Cisco Wireless LAN Controller.
  - When you are downloading through the Cisco 4100 Series Wireless LAN Controller or Cisco 4400 Series Wireless LAN Controller service port, the TFTP server MUST be on the same subnet as the Service port, because the Service port is not routable.
  - When you are downloading through the Cisco 2000 Series Wireless LAN Controller, Cisco 4100 Series Wireless LAN Controller or Cisco 4400 Series Wireless LAN Controller DS (Distribution System) network port, the TFTP server can be on the same or a different subnet, because the DS port is routable.
- When you are planning to use an external TFTP server, use the **`ping <IP Address>`** command in a Command Prompt window to ensure that the Cisco WCS Server can contact the TFTP server.
- Use Cisco WCS **Configure / Switches** to navigate to the **All Switches** page.
- In the **All Switches** page, select the desired Cisco Wireless LAN Controller check box, select the Command **Download Software**, and click **GO** to have Cisco WCS display the **Download Software to Switch** page.
- When you are using the built-in Cisco WCS TFTP server, in the **Download Software to Switch** page, make sure that **TFTP Server on Cisco WCS System** check box is selected.

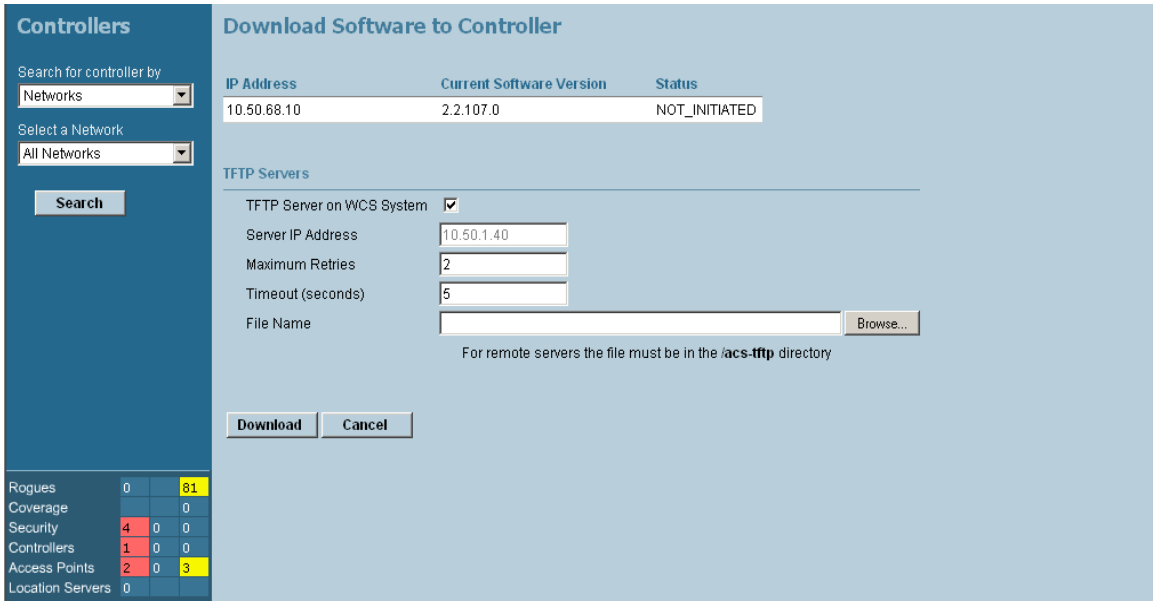
  -- OR --

  When you are using an external TFTP server, in the **Download Software to Switch** page, make sure that **TFTP Server on Cisco WCS System** is deselected. Then add the external TFTP server IP address.

- In the **Download Software to Switch** page, click the **Browse** button and navigate to the OS code update file named AS_2000_<release_number>.aes for Cisco 2000 Series Wireless LAN Controllers, or AS_4100_<release_number>.aes for Cisco 4100 Series Wireless LAN Controllers, or AS_4400_<release_number>.aes for Cisco 4400 Series Wireless LAN Controllers. (For example, AS_4100_3_0_60_0.aes.) The path and filename of the OS code appear in the **File Name** box.

  CAUTION: MAKE SURE you have the correct OS code file:

  - Cisco 2000 Series Wireless LAN Controller OS code files are named AS_2000_<release_number>.aes.
  - Cisco 4100 Series Wireless LAN Controller OS code files are named AS_4100_<release_number>.aes.
  - Cisco 4400 Series Wireless LAN Controller OS code files are named AS_4100_<release_number>.aes.



- Click the **Download** button.

  Cisco WCS downloads the OS code file to the Cisco WCS Server /aes-tftp directory, then downloads the OS code to the Cisco Wireless LAN Controller, and then the Cisco Wireless LAN Controller writes the code to flash RAM. As Cisco WCS performs these functions, it displays its progress in the **Status** box.

Refer to the *Transferring Files To and From a Cisco Wireless LAN Controller* section for other file upload and download instructions.

Managing Cisco WCS and Database

- *Installing Cisco WCS*
- *Updating the Windows Cisco WCS*
- *Updating the Linux Cisco WCS*
- *Reinitializing the Windows Cisco WCS Database*
- *Reinitializing the Linux Cisco WCS Database*
- *Administering Cisco WCS Users and Passwords*

Installing Cisco WCS

Refer to the Windows Cisco WCS Quick Start Guide or Linux Cisco WCS Quick Start Guide the for instructions on how to install Cisco WCS on a Cisco WCS Server.

Updating the Windows Cisco WCS

Do the following:

- If possible, stop all Cisco WCS User Interfaces (*Stopping a Cisco WCS User Interface*) to stabilize the database.
- Stop the Cisco WCS (*Stopping the Cisco WCS Windows Application* or *Stopping the Cisco WCS Windows Service*).
- Manually create a backup directory with no spaces in the name, such as C:\WCS30_Backup\.

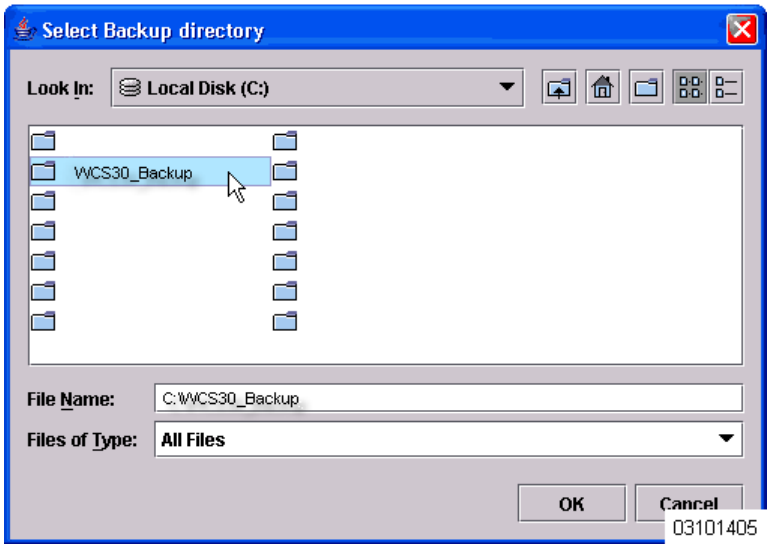
  Note: Make sure the directory name does not include any spaces, or the backup script will generate error messages.

- From the Windows **START** button, select the **Programs** menu, and then select **Wireless Control System /Backup**.

  The backup script opens the **Backup** DOS window and the **Select Backup directory** window.

- In the **Select Backup directory** window, highlight the backup directory you created above and click **OK**.

  The backup database script creates subdirectories in the C:\WCS30_Backup\ directory, and backs up the Cisco WCS database and the floor plan, building, and area maps to the C:\WCS30_Backup\conf and C:\WCS30_Backup\mapimages directories.



- When the **Backup Status** window opens and displays the `Backup Succeeded. You may restart the Cisco WCS Server now.` message, click **OK**.
- Uninstall the Cisco Wireless Control System application using the **Control Panel/Add or Remove Programs** application.
- When the **JExpress Uninstaller** window displays `Program uninstalled` message, click **Finished** to close the **JExpress Uninstaller** window.
- If any part of the **C:\Program Files\WCS30** folder remains on the hard drive, manually delete the folder and all contents.

> **Note:** If you fail to delete the previous Cisco WCS installation, you will receive the following error message upon reinstall: `Cisco WCS already installed. Please uninstall the older version before installing this version.`

- Reinstall the Cisco WCS application as described in *Installing Cisco WCS*.
- From the Windows **START** button, select the **Programs** menu, and then select **Cisco Wireless Control System / Restore**.
- In the **Select Backup directory** window, highlight the backup directory you created above and click **OK**.
- The restore database script restores the Cisco WCS database and the floor plan, building, and area maps to the new Cisco WCS installation.
- When the **Restore Status** page opens and displays the `Restore Succeeded. You may restart the Cisco WCS Server now.` message, click **OK**.

  If you receive an error message, scroll down the page to find the error. Normally, the only error that will halt a backup is if an incorrect directory is specified; if this is the case, repeat this procedure with the correct directory to complete the backup.
- Start the Cisco WCS as described in *Starting Cisco WCS as a Windows Application* or *Starting Cisco WCS as a Windows Service*.
- Start one or more Cisco WCS User Interfaces as described in *Starting a Cisco WCS User Interface*.

Updating the Linux Cisco WCS

Do the following:

- If possible, stop all Cisco WCS User Interfaces (*Stopping a Cisco WCS User Interface*) to stabilize the database.

Create a Backup Directory

- If not already done, log in as root.
- Using the Linux command line interface, navigate to the default **/opt/WCS 30/** directory (or any other directory).
- Create a backup directory for the Cisco WCS database with no spaces in the name; for instance, **mkdir WCS30BAK**.

Stop the Cisco WCS Server Application

- Navigate to the default **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./StopWCS** to stop the Cisco WCS application.

Back Up the Cisco WCS Server Database

- Enter **./Backup** to start the Cisco WCS database backup. The Backup script displays the **Select Backup directory** window.
- In the Select Backup directory window, navigate to the NAME of the backup directory you created above (not IN the directory), and click **OK**.
- When the Backup script displays the `Backup Succeeded. You may restart the Cisco WCS Server now` message, click **OK**.

Uninstall the Old Cisco WCS Server Application

- Enter **./uninstallAirespaceControlSystem** to uninstall the Cisco WCS application.
- Click **Yes** to continue with the uninstallation.
- Click **Finished** when the uninstallation is completed.

Restore the Cisco WCS Server Database

- Navigate to the default **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./Restore** to start the Cisco WCS database backup. The Backup script displays the **Select Backup directory** window.
- In the Select Backup directory window, navigate to the NAME of the backup directory you created above (not IN the directory), and click **OK**.
- When the Backup script displays `You may restart the Cisco WCS Server now`, click **OK**.

Start the Cisco WCS Server Application

- In the **/opt/WCS30** directory (or the directory chosen during installation).
- Enter **./StartWCS** to start the Cisco WCS application.
- Enter **./CheckServerStatus** to open the **Wireless Control System Server Status** window.
- When the Start Wireless Control System Server Status window displays `Wireless Control System Server is up. Please connect your clients (Cisco WCS User Interfaces) using Http Port: 80 or Https Port: 433` (or whichever HTTP: or HTTPS: port you selected in the Install the New Cisco WCS Server Application step), Cisco WCS has started and is ready to host Cisco WCS User Interfaces.

CAUTION: When you plan to shut down Cisco WCS, refer to *Starting and Stopping Linux Cisco WCS*.

Reinitializing the Windows Cisco WCS Database

You only have to reinitialize the Windows Cisco WCS database when the Cisco WCS database becomes corrupted.

> **CAUTION:** If you reinitialize the Cisco WCS database after you have been working in the Cisco WCS application, you will delete all your saved Cisco WCS data!

- Navigate to the \WCS30 directory.
- Navigate to the \bin subdirectory.
- In the \bin subdirectory, double-click the reinitDatabase.bat file.

  The database reinitialize script displays the **startdb.bat** DOS window.
- Select the **startdb.bat** window, and press any key to continue.

  The startdb.bat script displays the **Reinitialize Web NMS Database** window.
- In response to the `Do you want to Reinitialize Web NMS?` prompt in the **Reinitialize Web NMS Database** window, select **Yes**.

  The **startdb.bat** window displays many "accomplished" messages. When the Cisco WCS database is reinitialized, the **Reinitialize Web NMS Database** window reappears.
- In response to the `Successfully reinitialized the Database` prompt in the **Reinitialize Web NMS Database** window, select OK.

  The **Reinitialize Web NMS Database** window closes, and the **startdb.bat** window displays a `Press any key to continue` prompt.
- In the **startdb.bat** window, press any key. The **startdb.bat** window closes.

You have reinitialized the Cisco WCS database. Continue with *Using the Cisco Wireless Control System*.

Reinitializing the Linux Cisco WCS Database

You only have to reinitialize the Linux Cisco WCS database when the Cisco WCS database becomes corrupted.

> **CAUTION:** If you reinitialize the Cisco WCS database after you have been working in the Cisco WCS application, you will delete all your saved Cisco WCS data!

- If not already done, log in as root.
- Using the Linux command line interface, navigate to the default **/opt/WCS30/** directory (or the directory chosen during installation).
- Enter **./reinitDatabase.sh** to reinitialize the Cisco WCS database.

You have reinitialized the Cisco WCS database. Continue with *Using the Cisco Wireless Control System*.

Administering Cisco WCS Users and Passwords

Cisco WCS supports four user groups:

- To monitor Cisco WCS operations, users must be part of the **System Monitoring** Group.
- To monitor and configure Cisco WCS operations, users must be part of the **ConfigManagers** Group.
- To monitor and configure Cisco WCS operations, and perform all system administration tasks except administering Cisco WCS users and passwords, users must be part of the **Admin** Group.
- To monitor and configure Cisco WCS operations, and perform all system administration tasks including administering Cisco WCS users and passwords, users must be part of the **SuperUsers** Group.

This section describes how to add user accounts and assign them to a user group, change passwords, and delete user accounts using the Cisco WCS Administration function.

Adding User Accounts

- If not already done, start the Cisco WCS as described in the *Starting Cisco WCS as a Windows Application* or *Starting Cisco WCS as a Windows Service*.

  CAUTION: As soon as you have logged into the Cisco WCS User Interface as **Super1**, Cisco WLAN Solution recommends that you create a new superuser assigned to the Super Users Group, and then delete the **Super1** user to prevent undesired access to Cisco WCS Super User operations.

- Select **User Admin / Security Administration** to display the **Security Administration** page.
- In the **Security Administration** page, click the **Add User** (single person) icon to display the **User Administration** page.
- In the **User Administration** page, add the new username and password. Click **Next** to display the **User account expiry** and **Password expiry** parameters.
- In this page, accept or change the desired expiration times for the user account and password. Click **Next** to display the **Group based permissions, Direct Assignment,** and **Assign groups for the user** parameters.
- As you are going to assign the new user account to a group which already has permissions assigned, make sure the **Group based permissions** and **Direct Assignment** boxes are checked.
- In the **Assign groups for the user** section, assign the new user account to one of the four user group names: **System Monitoring**, **ConfigManagers**, **Admin**, or **SuperUsers**.
- Ignore the rest of the fields in this page, and click **Finish** to complete adding the new user account.
- Close the **Security Administration** page.
- Close the **Cisco Wireless Control System Release 3.0** page.

The new User Account has been added and can be used immediately. If necessary, refer to the *Deleting User Accounts* section to delete the default user accounts provided with Cisco Wireless Control System.

Changing Passwords

- If not already done, start the Cisco WCS as described in the *Starting Cisco WCS as a Windows Application* or *Starting Cisco WCS as a Windows Service*.
- If not already done, log into Cisco WCS Administration as a user assigned to the **SuperUsers** Group as described in *Adding User Accounts*.
- Select **User Admin / Security Administration** to display the **Security Administration** page.
- In the **Security Administration** page, highlight a user account, and select **Edit / Change Password** to display the **Change Password** dialog.
- In the **Change Password** dialog, enter the new password and click **Ok** to change the password for the selected user account.
- Close the **Security Administration** page.
- Close the **Cisco Wireless Control System Release 3.0** page.

The User Account has been changed and can be used immediately.

Deleting User Accounts

- If not already done, start the Cisco WCS as described in the *Starting Cisco WCS as a Windows Application* or *Starting Cisco WCS as a Windows Service*.
- If not already done, log into Cisco WCS Administration as a user assigned to the **SuperUsers** Group as described in *Adding User Accounts*.
- Select **User Admin / Security Administration** to display the **Security Administration** page.
- In the **Security Administration** page, highlight the user account to delete, and select **Edit / Delete** to display the **Warning! On deleting this user you would no longer be able to log on with this user name, are you sure you want to do this?** dialog.
- In the **Warning!** dialog, click **Yes** to delete the selected user account.
- Close the **Security Administration** page.
- Close the **Cisco Wireless Control System Release 3.0** page.

The deleted User Account can no longer be used.

Using the Web User Interface

The Web User Interface is described in Web User Interface section.

Note that you can use either the *Service-Port Interface* (recommended) or *Management Interface*, whose IP Address(es) were set using the *Startup Wizard* or the *Configuring System Parameters* section. Also note that you can have up to 21 simultaneous web browser sessions, but the automatic refresh time for the Monitor/Summary page will be longer if there are more than 10 simultaneous sessions.

> **Note:** Some popup window filters can be configured to block the Web User Online Help pages. If your system cannot display the Online Help windows, disable or reconfigure your browser popup filter software.

Log into the Web User Interface by doing the following:

- Start a web browser on any workstation connected to the Internet (Cisco recommends Internet Explorer 6.0 or later on a Windows workstation for full functionality).

- For an unsecure http connection, enter the Cisco Wireless LAN Controller IP Address (http://<Cisco Wireless LAN Controller_IPaddress>/) in the web browser Address field and press <RETURN>.

  --OR--

  For a secure https (HTTP + SSL) connection, enter the Cisco Wireless LAN Controller IP Address (https://<Cisco Wireless LAN Controller_IPaddress>/) in the web browser Address field and press <RETURN>. (This connection was configured using the *Adding SSL to the Web User Interface* procedure.)

  Note: If you receive a "The Document contains no data" error message, the corresponding http Web Mode and/or https Secure Web Mode is disabled. If you receive the error when attempting to use http AND https, use the CLI to log into the Cisco Wireless LAN Controller as described in the *Using the Cisco WLAN Solution CLI* section, or use Cisco WCS to log into the Cisco Wireless LAN Controller as described in *Using the Cisco Wireless Control System*.

  Note: Each time you access the secure https (http + SSL) Cisco Wireless LAN Controller website, you may receive the following Security Alert:

Security Alert
Information you exchange with this site cannot be viewed or changed by others. However, there is a problem with the site's security certificate.
The security certificate was issued by a company you have not chosen to trust. View the certificate to determine whether you want to trust the certifying authority.
The security certificate date is valid.
The security certificate has a valid name matching the name of the page you are trying to view.
Do you want to proceed?
Yes
No
View Certificate
09100301

  When you see the Security Alert, click **Yes**.

After you have logged into the Web User Interface, use the context-sensitive (F1) online help (included in the *Operating System Software* section) to configure and monitor the Cisco Wireless LAN Controller.

Adding Cisco 1000 Series Lightweight Access Points to a Cisco Wireless LAN Controller

Cisco 1000 Series lightweight access points connect to the Cisco Wireless LAN Controller through the network as described in Cisco WLAN Solution Wired Connections. When a Cisco 1000 Series lightweight access point powers up, it searches for a Cisco Wireless LAN Controller as described in *Cisco Wireless LAN Controller Failover Protection*.

Adding CA Certificates to a Cisco Wireless LAN Controller

Certification Authority public-key certificates are used to authenticate the Web server and encrypt data transmissions between Web server and browser. The CA certificates are issued by a trusted Certification Authority, or CA.

Note: You can obtain a CA Certificate from three sources: Factory-supplied, Operator-generated, and Purchased from a trusted CA. This procedure only applies to adding an Operator-generated or Purchased ID Certificate, as the factory-supplied Certificate is already stored in the Cisco Wireless LAN Controller NVRAM. You do not need to complete this procedure if you choose to use the factory-supplied CA Certificate.

CAUTION: Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

When you obtain certificates (usually in an email from the CA or from your key-generation program), it is a simple matter to add the CA certificate to your Cisco Wireless LAN Controller:

- Launch a Web User Interface session as described in *Using the Web User Interface*.
- Navigate to the CA Certification page in the Web User Interface.
- Copy the Certificate (a large block of ASCII characters) from your email or text viewer program, and paste it into the CA Certification box.
- Click **Apply**.

The CA Certificate is now in the Cisco Wireless LAN Controller Volatile RAM. Use ‘System Reboot with Save’ to save the CA Certificate to NVRAM, so the CA Certificate is preserved across restarts.

Adding ID Certificates to a Cisco Wireless LAN Controller

ID Certificates and Private Keys are used by Web server operators to ensure secure server operation. The ID certificate and key are used to authenticate the server and encrypt data transmissions between server and browser.

Note: You can obtain an ID Certificate and Private Key from three sources: Factory-supplied, Operator-generated, and Purchased from a trusted CA. This procedure only applies to adding an Operator-generated or Purchased ID Certificate and Key, as the factory-supplied Certificate and Key are already stored in the Cisco Wireless LAN Controller NVRAM. You do not need to complete this procedure if you choose to use the factory-supplied ID Certificate and Key.

CAUTION: Each certificate has a variable-length embedded RSA Key. The RSA key can be from 512 bits, which is relatively insecure, through thousands of bits, which is very secure. When you are obtaining a new certificate from a Certificate Authority (such as the Microsoft CA), MAKE SURE the RSA key embedded in the certificate is AT LEAST 768 Bits.

When you obtain ID certificates (usually in an email from the CA or from your key-generation program), it is a simple matter to add the ID certificate and key to your Cisco Wireless LAN Controller:

- Launch a Web User Interface session as described in *Using the Web User Interface*.
- Navigate to the ID Certificate > New page in the Web User Interface.
- Type or paste the ID Certificate Name into the Certificate Name box.
- Type a Private Key (Password) into the Certificate Password box.
- Copy the Certificate (a large block of ASCII characters) from your email or text viewer program, and paste it into the ID Certification box.
- Click **Apply**.

The ID Certificate and Key are now in the Cisco Wireless LAN Controller Volatile RAM. Use 'System Reboot with Save' to save the ID Certificate and Key to NVRAM, so the Certificate and Key are preserved across restarts.

Configuring and Operating Cisco 2700 Series Location Appliances

The Cisco 2700 Series Location Appliance (location appliance) is a Cisco server that collects and stores up to 30 days of historical location data for up to 1,500 Laptop Clients, Palmtop Clients, VoIP Telephone Clients, RFID (Radio Frequency IDentifier) Asset Tags, Rogue Access Points, and Rogue Access Point Clients for each location appliance.

Each location appliance must be initially configured using a CLI console, as described in the Cisco 2700 Series Location Appliance Quick Start Guide.

After the location appliance is initially configured, the rest of the configuration and operation tasks are controlled using Cisco WCS 3.0, as described in the following sections:

- *Configuring Location Appliances*
- *Operating the Location Appliances*

Configuring Location Appliances

After initial configuration using a CLI console, the Cisco 2700 Series Location Appliance (location appliance) is very easy to configure using Cisco WCS 3.0. This section describes the tasks required to complete the location appliance configuration:

- *Adding a Location Appliance to the Cisco WCS Database*
- *Editing a Location Appliance Contact, User Name, Password, and HTTP/HTTPS Selection*
- *Synchronizing Location Appliance and Cisco WCS Network Designs*
- *Synchronizing Cisco Wireless LAN Controllers and Location Appliances*
- *Editing Location Appliance Polling Parameters*
- *Editing Location Appliance History Parameters*
- *Editing Location Appliance Location Parameters*
- *Adding Location Appliance User Groups*
- *Changing Location Appliance User Group Permissions*
- *Deleting Location Appliance User Groups*
- *Adding Location Appliance Users*
- *Changing Location Appliance User Passwords, Group Names, and Permissions*
- *Deleting Location Appliance Users*
- *Adding Location Appliance Host Access*
- *Deleting Location Appliance Host Access*
- *Editing Location Appliance Advanced Parameters*
- *Clearing the Location Appliance Configurations*
- *Deleting a Location Appliance from the Cisco WCS Database*

Adding a Location Appliance to the Cisco WCS Database

After initial configuration using a CLI console, follow these steps in the Cisco WCS interface:

1. Verify that you can ping the Cisco 2700 Series Location Appliance (location appliance) from the Cisco WCS Server. If not, correct the connection between Cisco WCS and the location appliance.
2. Select **LOCATE** to display the **All Location Appliances** page.
3. In the right-hand command drop-down menu, select **Add Server** and then click **GO** to display the **Location Appliance > General Properties > New** page.
4. Add or skip an optional location appliance Name.
5. Add the location appliance IP Address.
6. Add or skip the optional Contact Name.
7. When required, change the username and password (default = admin/admin).
8. When required, change the port (default = 8001).
9. When required, enable or disable HTTPS (default = HTTPS disabled).

10. Click **Save**. Cisco WCS searches for the location appliance and adds it to the Cisco WCS database.

    Note: When Cisco WCS has Network Designs (campus, building, or outdoor maps) or Cisco Wireless LAN Controllers that are unassigned to a location appliance, Cisco WCS may automatically redirect you to the **Synchronize Cisco WCS and Location Appliance(s)** page.

    When Cisco WCS does this, refer to the *Synchronizing Location Appliance and Cisco WCS Network Designs* or *Synchronizing Cisco Wireless LAN Controllers and Location Appliances* sections.

11. Navigate to the **All Location Appliances** page and click **Refresh**. Verify that the location appliance appears on the page.

You have added the location appliance to the Cisco WCS database. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Editing a Location Appliance Contact, User Name, Password, and HTTP/HTTPS Selection

After adding a Cisco 2700 Series Location Appliance (location appliance) to the Cisco WCS database, follow these steps in the Cisco WCS interface:

1. Select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Make the required changes to the Contact Name, User Name, Password, and/or HTTP/HTTPS value.
4. Click **Save** to update the Cisco WCS and location appliance databases.

You have edited the location appliance General Properties in the Cisco WCS and location appliance databases. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Synchronizing Location Appliance and Cisco WCS Network Designs

After adding a Cisco 2700 Series Location Appliance (location appliance) to the Cisco WCS database, you can choose to add (synchronize) Cisco WCS campus, building, and outdoor maps (Network Designs) to the location appliance database. After the Network Designs are stored in the Cisco WCS and location appliance databases, you can re-synchronize the two databases at any time. In the Cisco WCS interface:

1. Select **LOCATE** to display the **All Location Appliances** page.
2. In the right-hand command drop-down menu, select **Synchronize Servers** and then click **GO** to display the **Synchronize Cisco WCS and Location Appliance(s)** page.
3. Select **Synchronize Network Designs**.
4. In the required Network Design row, click **Assign** to have Cisco WCS display the **Assign to servers** popup window.
5. In the Assign to servers window, check the required location appliance(s).
6. Click **OK** to return to the **Synchronize Cisco WCS and Location Appliance(s)** page.

   Note that the **Assign** button in the assigned Network Design row now has a star next to it.
7. Click **Synchronize** to update the Cisco WCS and location appliance databases.

When you have successfully associated the Controller and location appliance databases, the **Sync. Status** shows a green two-arrow icon.

You have edited the location appliance General Properties in the Cisco WCS and location appliance databases. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Synchronizing Cisco Wireless LAN Controllers and Location Appliances

After adding a Cisco 2700 Series Location Appliance (location appliance) and Cisco Wireless LAN Controllers to the Cisco WCS database, you can choose to associate (synchronize) Cisco Wireless LAN Controller databases with location appliance databases. After the Cisco Wireless LAN Controllers and location appliance are synchronized, you can re-synchronize any two databases at any time.

> **Note:** Before a location appliance can collect any data, it must be associated with one or more Cisco Wireless LAN Controllers as described in *Assigning Controllers to Cisco Wireless LAN Controllers*.

Assigning Controllers to Cisco Wireless LAN Controllers

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. In the right-hand command drop-down menu, select **Synchronize Servers** and then click **GO** to display the **Synchronize Cisco WCS and Location Appliance(s)** page.
3. In the Synchronize Cisco WCS and Location Appliance(s) page, select **Synchronize Switches**.
4. Highlight the required Cisco Wireless LAN Controller name, and select the required location appliance name.
5. Click **Synchronize** to associate (assign) the Controller and location appliance databases.

When you have successfully associated the Controller and location appliance databases, the **Sync. Status** shows a green two-arrow icon.

Unassigning Controllers to Cisco Wireless LAN Controllers

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. In the right-hand command drop-down menu, select **Synchronize Servers** and then click **GO** to display the **Synchronize Cisco WCS and Location Appliance(s)** page.
3. Select **Synchronize Switches**.
4. Highlight the required Cisco Wireless LAN Controller name, and select the **--Unassigned--** location appliance name.
5. Click **Synchronize** to unassign (disassociate) the Controller and location appliance databases.

When you have successfully unassigned the Controller and location appliance databases, the **Sync. Status** shows a red two-arrow icon.

You can view the current synchronized status as described in the *Viewing Cisco Wireless LAN Controller and Location Appliance Synchronization Status* section. Otherwise, return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Editing Location Appliance Polling Parameters

After adding a Cisco 2700 Series Location Appliance (location appliance) to the Cisco WCS database, you can modify the independent Client, Rogue Access Point, Asset Tag, and Statistics polling periods that the location appliance uses to poll its associated Cisco Wireless LAN Controllers. Note that this is independent of the number of times Cisco WCS users may request a data refresh from the location appliance.

> **Note:** Before the location appliance can collect any data, it must be associated with one or more Cisco Wireless LAN Controllers as described in *Assigning Controllers to Cisco Wireless LAN Controllers*.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Polling Parameters** to have Cisco WCS display the **Location Appliance > Polling Parameters > <LocAppliance Name>** page.
4. Set the following:
   - **Retry Count**: Enter the number of times to retry a polling cycle between 1 and 99999, default = 3. The Retry Count generally does not need to be changed from the default.
   - **Timeout**: Enter the number of seconds for a polling timeout between 1 and 99999, default = 5 seconds. The Timeout generally does not need to be changed from the default.
   - **Client Station Polling and Interval**: Select the check box to turn Polling on, and enter the number of seconds between Client polling attempts between 1 and 99999, default = Polling disabled and a 300 second interval. You may want to leave Client Polling off, and you may want to change the Polling Interval to a shorter or longer value for more or less granular data collection, respectively.

     Note that the Polling Interval is the period between the end of a preceding polling cycle and the beginning of the next polling cycle. That is, if the polling cycles take five minutes to complete, and the Polling Interval is ten minutes, the time between the start of polling cycles is fifteen minutes.
   - **Rogue AP Polling and Interval**: Select the check box to turn Polling on, and enter the number of seconds between rogue access point polling attempts between 1 and 99999, default = disabled and a 600 second interval. You may want to leave rogue access point Polling off, and you may want to change the Polling Interval to a shorter or longer value for more or less granular data collection, respectively.

     Note that the Polling Interval is the period between the end of a preceding polling cycle and the beginning of the next polling cycle. That is, if the polling cycles take five minutes to complete, and the Polling Interval is ten minutes, the time between the start of polling cycles is fifteen minutes.
   - **Asset Tag Polling and Interval**: Select the check box to turn Polling on, and enter the number of seconds between Asset Tag polling attempts between 1 and 99999, default = disabled and a 600 second interval. You may want to leave Asset Tag Polling off, and you may want to change the Polling Interval to a shorter or longer value for more or less granular data collection, respectively.

     Note that the Polling Interval is the period between the end of a preceding polling cycle and the beginning of the next polling cycle. That is, if the polling cycles take five minutes to complete, and the Polling Interval is ten minutes, the time between the start of polling cycles is fifteen minutes.

> **Note:** Before the location appliance can collect Asset Tag data, its associated Cisco Wireless LAN Controllers must have the following command entered in their CLI interfaces: **`config rfid status enable`**.

- **Statistics Polling and Interval**: Select the check box to turn Polling on, and enter the number of seconds between Statistics polling attempts between 1 and 99999, default = disabled and a 900 second interval. You may want to leave Statistics Polling off, and you may want to change the Polling Interval to a shorter or longer value for more or less granular data collection, respectively.

  Note that the Polling Interval is the period between the end of a preceding polling cycle and the beginning of the next polling cycle. That is, if the polling cycles take five minutes to complete, and the Polling Interval is ten minutes, the time between the start of polling cycles is fifteen minutes.

5. When you have made the required selections, click **Save** to store your selections in the Cisco WCS and location appliance databases.

You have edited the location appliance Polling Parameters in the Cisco WCS and location appliance databases. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Editing Location Appliance History Parameters

After adding a Cisco 2700 Series Location Appliance (location appliance) to the Cisco WCS database, you can independently modify the client, rogue access point, and asset tag histories that the location appliance collects from its associated Cisco Wireless LAN Controllers. You can also program the location appliance to periodically prune duplicate data from its historical files to reduce the amount of data stored on its hard drive. Note that Cisco WCS users can display the location appliance historical data at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **History Parameters** to have Cisco WCS display the **Location Appliance > History Parameters > <LocAppliance Name>** page.
4. Set the following:
   - **Archive for**: Enter the number of days for the location appliance to retain a history of each enabled category between 1 and 30 days, default = 30. This number can be changed from the default to meet Cisco WCS users' needs.
   - **Prune data starting at**: Enter the number of hours and minutes (between 0 and 23 hours, and between 1 and 59 minutes) for the location appliance to collect historical data before starting pruning, and enter the number of minutes between each pruning operation (between 0, or never, and 99900000). Default start = 23 hours and 50 minutes, and interval =1440 minutes. This number can be changed from the default to meet Cisco WCS users' needs.
   - **Client Station History and Interval**: Select the check box to turn Historical data collection on, and enter the number of minutes between Historical data storage events between 1 and 99999, default = History Collection disabled and a 360 minute interval. You may want to leave Client History Collection off, and you may want to change the History Collection Interval to a shorter or longer value for more or less granular data collection, respectively.

- **Rogue AP History and Interval**: Select the check box to turn Historical data collection on, and enter the number of minutes between Historical data storage events between 1 and 99999, default = History Collection disabled and a 720 minute interval. You may want to leave rogue access point History Collection off, and you may want to change the History Collection Interval to a shorter or longer value for more or less granular data collection, respectively.
- **Asset Tag History and Interval**: Select the check box to turn Historical data collection on, and enter the number of minutes between Historical data storage events between 1 and 99999, default = History Collection disabled and a 720 minute interval. You may want to leave Asset Tag History Collection off, and you may want to change the History Collection Interval to a shorter or longer value for more or less granular data collection, respectively.

▶ **Note:** Before the location appliance can collect Asset Tag data, its associated Cisco Wireless LAN Controllers must have the following command entered in their CLI interfaces: **`config rfid status enable`**.

5. When you have made the required selections, click **Save** to store your selections in the Cisco WCS and location appliance databases.

You have edited the location appliance History Parameters in the Cisco WCS and location appliance databases. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Editing Location Appliance Location Parameters

After adding a Cisco 2700 Series Location Appliance (location appliance) to the Cisco WCS database, you can independently modify whether or not the location appliance retains its heatmap persistence, whether or not the location appliance retains its calculation times, and how soon the location appliance deletes its collected RSSI measurement times. Note that Cisco WCS users can display the location appliance historical data at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Location Parameters** to have Cisco WCS display the **Location Appliance > Location Parameters > <LocAppliance Name>** page.
4. Set the following:
   - **Enable heatmap persistence**: Select the check box to have the location appliance retain its heatmap persistence (default = heatmap persistence disabled).
   - **Enable calculation time**: Select the check box to have the location appliance retain its calculation times (default = calculation times disabled).
   - **Discard RSSI measurement time**: Enter the number of minutes (between 0 and 99999 minutes) for the location appliance to retain its collected RSSI values (default = 480 minutes). After this time, the location appliance purges its older RSSI values.
5. When you have made the required selections, click **Save** to store your selections in the Cisco WCS and location appliance databases.

You have edited the location appliance Location Parameters in the Cisco WCS and location appliance databases. Return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Adding Location Appliance User Groups

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete user groups and users. Perform the following to add a new user group:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Groups** to have Cisco WCS display the **Location Appliance > Groups > <LocAppliance Name>** page.
4. In the right-hand command drop-down menu, select **Add Group** and then click **GO** to display the **New Group** page.
5. Enter the new group name and assign a Read Access, Write Access, or Full Access permission for the group.
6. Click **Save** to add the new group to the location appliance.

To change permissions for an existing user group, refer to *Changing Location Appliance User Group Permissions*. To delete an existing user group, refer to *Deleting Location Appliance User Groups*. To add a new User, refer to *Adding Location Appliance Users*. Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Changing Location Appliance User Group Permissions

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to change existing user group permissions. Perform the following to change user group permissions:

> **Note:** Group permissions override individual user permissions. Thus, a superuser could be set up with full read and write permissions, but if the superuser is assigned to a group with read-only permissions, the superuser cannot edit the Cisco 2700 Series Location Appliance configuration.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Groups** to have Cisco WCS display the **Location Appliance > Groups > <LocAppliance Name>** page.
4. Click a **Group Name** to have Cisco WCS display the **Modify Group > <Group Name>** page.
5. Change the group permission to Read Access, Write Access, or Full Access.
6. Click **Save** to save the new user group permission to the location appliance, and return to the **Location Appliance > Groups > <LocAppliance Name>** page.

Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Deleting Location Appliance User Groups

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete user groups and users. Perform the following to delete an existing user group:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.

3. Click **Groups** to have Cisco WCS display the **Location Appliance > Groups > <LocAppliance Name>** page.
4. Check the desired Group.
5. In the right-hand command drop-down menu, select **Delete Group** and then click **GO** to start the deletion.
6. Click **OK** to complete the deletion.

To add a new user group, refer to *Adding Location Appliance User Groups*. To change permissions for an existing user group, refer to *Changing Location Appliance User Group Permissions*. To add a new User, refer to *Adding Location Appliance Users*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Adding Location Appliance Users

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete user groups and users. Perform the following to add a new User:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Users** to have Cisco WCS display the **Location Appliance > Users > <LocAppliance Name>** page.
4. In the right-hand command drop-down menu, select **Add User** and then click **GO** to display the **New User** page.
5. Enter the new User Name, Password, and an existing Group Name. Assign a Read Access, Write Access, or Full Access permission for the User.
6. Click **Save** to add the new User to the location appliance.

> **Note:** Group permissions override individual user permissions. Thus, a superuser could be set up with full read and write permissions, but if the superuser is assigned to a group with read-only permissions, the superuser cannot edit the Cisco 2700 Series Location Appliance configuration.

To change values for an existing user, refer to *Changing Location Appliance User Passwords, Group Names, and Permissions*. To delete an existing user, refer to *Deleting Location Appliance Users*. To add a new user group, refer to *Adding Location Appliance User Groups*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Changing Location Appliance User Passwords, Group Names, and Permissions

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to change existing user values. Perform the following to change User values:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Users** to have Cisco WCS display the **Location Appliance > Users > <LocAppliance Name>** page.
4. Click a **Username** to have Cisco WCS display the **Modify User > <User Name>** page.

5. Change the User Password, Group Name, or permission to Read Access, Write Access, or Full Access.
6. Click **Save** to save the new user values to the location appliance, and return to the **Location Appliance > Users > <LocAppliance Name>** page.

To add a new user, refer to *Adding Location Appliance User Groups*. To delete a user, refer to *Deleting Location Appliance Users*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Deleting Location Appliance Users

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete user groups and users. Perform the following to delete an existing user:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Users** to have Cisco WCS display the **Location Appliance > Users > <LocAppliance Name>** page.
4. Check the desired user.
5. In the right-hand command drop-down menu, select **Delete User** and then click **GO** to start the deletion.
6. Click **OK** to complete the deletion.

To add a new user, refer to *Adding Location Appliance Users*. To change values for an existing user, refer to *Changing Location Appliance User Passwords, Group Names, and Permissions*. To add a new user group, refer to *Adding Location Appliance User Groups*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Adding Location Appliance Host Access

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete host access. Perform the following to add a new host access:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Host Access** to have Cisco WCS display the **Location Appliance > Host Access > <LocAppliance Name>** page.
4. In the right-hand command drop-down menu, select **Add Host Access** and then click **GO** to display the **New Host Access** page.
5. Enter the new host access and netmask, whether or not it is permitted (default = not permitted), its priority (from 0 to 99999, default = 0), and its start and end access (from 0-23 Hours and 0-59 Minutes, default = 0 Hours and 0 Minutes).
6. Click **Save** to add the new host access to the location appliance.

To delete an existing host access, refer to *Deleting Location Appliance Host Access*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Deleting Location Appliance Host Access

The Cisco 2700 Series Location Appliance (location appliance) allows superusers to add and delete host access. Perform the following to delete an existing host access:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Host Access** to have Cisco WCS display the **Location Appliance > Host Access > <LocAppliance Name>** page.
4. Check the desired IP Address/netmask.
5. In the right-hand command drop-down menu, select **Delete Host Access** and then click **GO** to start the deletion.
6. Click **OK** to complete the deletion.

To add a new User, refer to *Adding Location Appliance Users*. To change values for an existing User, refer to *Changing Location Appliance User Passwords, Group Names, and Permissions*. To add a new user group, refer to *Adding Location Appliance User Groups*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Editing Location Appliance Advanced Parameters

At any time, you can change the following Cisco 2700 Series Location Appliance (location appliance) Advanced Parameters:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. Change the following parameters, as required:
   - Current Logging Level (Trace, Information, Error, or Off; default = Information). Leave this setting as Information, unless directed to do otherwise by Cisco Technical Assistance Center (TAC).
   - Enable or Disable Advanced Debugging (default = Disabled). Leave this setting as Disabled, unless directed to do otherwise by Cisco Technical Assistance Center (TAC).
   - Current Number of Days to Keep Events (default = 7 days). Change this value as required by Cisco WCS users and troubleshooters.
   - Current Session Timeout in minutes (default = 30 minutes). Change this value as required by location appliance troubleshooters.
   - Current Cleanup Data Interval in minutes (default = 7 days). Change this value as required by location appliance troubleshooters.
5. Click **Save** to update the Cisco WCS and location appliance databases.

In the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can view more Advanced Parameters as described in *Viewing Location Appliance Current Status*. From the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can perform some other operations as described in *Running Java GC on the Location Appliance Memory*, *Clearing the Location Appliance Configurations*, *Defragmenting the Location Appliance Database*, *Restarting the*

Location Appliance Application Software, and *Restarting the Location Appliance Application Software*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Clearing Location Appliance Configurations

At any time you can clear the Cisco 2700 Series Location Appliance (location appliance) configurations and restore the factory defaults:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. Select **Clear Configuration**.
5. Click **OK** to clear the location appliance configurations.

Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Deleting a Location Appliance from the Cisco WCS Database

Follow these steps in the Cisco WCS interface:

1. Select **LOCATE** to display the **All Location Appliances** page.
2. Select the desired Cisco 2700 Series Location Appliance (location appliance) check box(es), select the Command **Delete Server(s)**, and click **GO** to have Cisco WCS display the `Are you sure you want to delete the selected Location Appliance(s)?` dialog.
3. Click **OK** to have Cisco WCS delete the location appliance(s) from its database.

You have deleted the selected location appliance(s) from the Cisco WCS database. Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Operating Location Appliances

- *Viewing Location Appliance Alarms*
- *Assigning and Unassigning Location Appliance Alarms*
- *Deleting and Clearing Location Appliance Alarms*
- *Viewing Location Appliance Alarm Events*
- *Viewing Location Appliance Events*
- *Backing Up Location Appliance Historical Data*
- *Restoring Location Appliance Historical Data*
- *Viewing Cisco Wireless LAN Controller and Location Appliance Synchronization Status*
- *Re-Synchronizing Cisco Wireless LAN Controller and Location Appliance Databases*
- *Viewing Location Appliance Current Status*
- *Downloading Location Appliance Log Files to Your Cisco WCS Terminal*
- *Downloading Application Code to a Location Appliance using Cisco WCS*
- *Defragmenting the Location Appliance Database*
- *Running Java GC on the Location Appliance Memory*
- *Restarting the Location Appliance Application Software*
- *Rebooting the Location Appliance*

Viewing Location Appliance Alarms

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Alarms** to have Cisco WCS display the **Alarms** page.
4. In the Alarms page left navigation bar, select the required **Alarm Severity** and **Alarm Category**, and click **Search** to have Cisco WCS display the selected alarms page.

To assign alarms to yourself or unassign alarms from yourself, refer to *Assigning and Unassigning Location Appliance Alarms*. To delete or clear alarms from the Cisco WCS database, refer to *Deleting and Clearing Location Appliance Alarms*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Assigning and Unassigning Location Appliance Alarms

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Alarms** to have Cisco WCS display the **Alarms** page.
4. In the left navigation bar, select the required **Alarm Severity** and **Alarm Category**, and click **Search** to have Cisco WCS display the selected alarms page.
5. Select the check box(es) of the alarm(s) you are assigning to or unassigning from yourself.
6. In the selected Alarms page right drop-down menu, select **Assign to Me** or **Unassign**, as required.

To delete or clear alarms from the Cisco WCS database, refer to *Deleting and Clearing Location Appliance Alarms*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Deleting and Clearing Location Appliance Alarms

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Alarms** to have Cisco WCS display the **Alarms** page.
4. In the left navigation bar, select the required **Alarm Severity** and **Alarm Category**, and click **Search** to have Cisco WCS display the selected alarms page.
5. Select the check box(es) of the alarm(s) you are deleting or clearing.
6. In the selected Alarms page right drop-down menu, select **Delete** or **Clear**, as required.

To assign alarms to yourself or unassign alarms from yourself, refer to *Assigning and Unassigning Location Appliance Alarms*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Viewing Location Appliance Alarm Events

> **Note:** Only 1000 alarm events are retained in the Cisco 2700 Series Location Appliance (location appliance) database at any time. This means that Cisco WCS can display at most only the most recent 1000 events.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. Click **Events** to have Cisco WCS display the **Alarm > Events** page.
4. In the left navigation bar, select the required **Event Severity** and **Event Category**, and click **Search** to have Cisco WCS display the selected Alarm > Events page.
5. To view more detail for an event, click on a Failure Object name to have Cisco WCS display the selected **Alarm > Events > Location Appliance <LocAppliance Name>** page.

Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Viewing Location Appliance Events

Cisco WCS users can download zipped log files from a Cisco 2700 Series Location Appliance (location appliance) at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Events** to have Cisco WCS display the **Location Appliance > Events > <LocAppliance Name>** page.

The Events include a Timestamp, Severity, the Event, and associated Facility. Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Backing Up Location Appliance Historical Data

Cisco WCS users can back up the historical data from a Cisco 2700 Series Location Appliance (location appliance) at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Backup** to have Cisco WCS display the **Location Appliance > Backup Operation > <LocAppliance Name>** page.

   Notice that the backup is always stored in the C:\Program Files\Cisco WCS30\webnms\.\ftp-server\root Windows Cisco WCS directory.
4. In the Location Appliance > Backup Operation > <LocAppliance Name> page, verify or change the Backup filename, with no spaces.
5. Enter the number of seconds for a backup timeout between 1 and 999, default = 5 seconds. The Timeout generally does not need to be changed from the default.
6. Click **Submit** to back up the historical data to the Cisco WCS Server hard drive.

This task is completed when Cisco WCS displays the `Backup has been completed` message. Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Restoring Location Appliance Historical Data

Cisco WCS users can restore backed-up historical data (refer to *Backing Up Location Appliance Historical Data*) from Cisco WCS to a Cisco 2700 Series Location Appliance (location appliance) at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Restore** to have Cisco WCS display the **Location Appliance > Restore Operation > <LocAppliance Name>** page.

   Notice that the backup is always stored in the C:\Program Files\Cisco WCS30\webnms\.\ftp-server\root Windows Cisco WCS directory.
4. In the Location Appliance > Backup Operation > <LocAppliance Name> page, select the backed-up historical data file to restore.
5. Enter the number of seconds for a restore timeout between 1 and 999, default = 5 seconds. The Timeout generally does not need to be changed from the default.

6. Click **Submit** to start the restore process.
7. Click **OK** to restore the historical data from the Cisco WCS Server hard drive.

This task is completed when Cisco WCS displays the `Restore has been completed` message. Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Viewing Cisco Wireless LAN Controller and Location Appliance Synchronization Status

After synchronizing (associating) Cisco Wireless LAN Controller and Cisco 2700 Series Location Appliance (location appliance) databases as described in *Assigning Controllers to Cisco Wireless LAN Controllers*, you can follow these steps to view their Synchronization status at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. In the right-hand command drop-down menu, select **Synchronize Servers** and then click **GO** to display the **Synchronize Cisco WCS and Location Appliance(s)** page.
3. Select **Synchronize Switches**.

When the Controller and location appliance databases are synchronized, the **Sync. Status** shows a green two-arrow icon. When the Controller and location appliance databases are not synchronized, the **Sync. Status** shows a red two-arrow icon.

After the Controllers and location appliances are synchronized, refer to *Re-Synchronizing Cisco Wireless LAN Controller and Location Appliance Databases* to re-synchronize the databases at any time. Otherwise, return to *Configuring Location Appliances* or *Operating the Location Appliances*.

Re-Synchronizing Cisco Wireless LAN Controller and Location Appliance Databases

After synchronizing (associating) Cisco Wireless LAN Controller and Cisco 2700 Series Location Appliance (location appliance) databases as described in *Assigning Controllers to Cisco Wireless LAN Controllers*, you can follow these steps to re-synchronize them at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. In the right-hand command drop-down menu, select **Synchronize Servers** and then click **GO** to display the **Synchronize Cisco WCS and Location Appliance(s)** page.
3. Select **Synchronize Switches**.
4. Highlight the required Cisco Wireless LAN Controller name, and select the required location appliance name.
5. Click **Synchronize** to synchronize the Controller and location appliance databases.

When you have successfully re-synchronized the Controller and location appliance databases, the **Sync. Status** shows a green two-arrow icon. When you have successfully unassigned the Controller and location appliance databases, the **Sync. Status** shows a red two-arrow icon.

You can view the current synchronized status as described in the *Viewing Cisco Wireless LAN Controller and Location Appliance Synchronization Status* section. Otherwise, return to *Configuring Location Appliances* or

Viewing Location Appliance Current Status

At any time, you can follow these steps to view the Cisco 2700 Series Location Appliance (location appliance) current status.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. View the following:
   - Product Name
   - Application Code Release
   - Time the location appliance Started
   - Current location appliance Time
   - Number of location appliance Restarts
   - Number of active User Sessions
   - Current Logging Level (Trace, Information, Error, or Off)
   - Current Number of Days to Keep Events
   - Whether or not Advanced Debugging is Enabled or Disabled
   - Current Session Timeout in minutes
   - Current Cleanup Data Interval in minutes
   - Memory Used by the location appliance
   - Memory Allocated to the location appliance
   - Maximum Memory in the location appliance
   - Database Virtual Memory Allocated to the location appliance

   Note: After upgrading the location appliance, the old release may show in the Cisco WCS User Interface but it will be refreshed after the scheduled refresh interval when the Cisco WCS contacts the location appliance.

In the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can change some of the Advanced Parameters as described in *Editing Location Appliance Advanced Parameters*. From the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can perform some other operations as described in *Running Java GC on the Location Appliance Memory*, *Clearing the Location Appliance Configurations*, *Defragmenting the Location Appliance Database*, *Restarting the Location Appliance Application Software*, and *Restarting the Location Appliance Application Software*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Downloading Location Appliance Log Files to Your Cisco WCS Terminal

Cisco WCS users can download zipped log files from a Cisco 2700 Series Location Appliance (location appliance) at any time.

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Logs** to have Cisco WCS display the **Location Appliance > Log Files > <LocAppliance Name>** page.
4. Click **Download Logs** to start the download process.
5. Click **Save** to download the zipped log files to your Cisco WCS terminal.

   -- OR --

   Click **Open** to view the downloaded log file.

Continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Downloading Application Code to a Location Appliance using Cisco WCS

1. Verify that you can ping the Cisco 2700 Series Location Appliance (location appliance) from the Cisco WCS Server or an external FTP server, whichever you are going to use for the application code download. If not, correct the connection between Cisco WCS or the FTP server and the location appliance.
2. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
3. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
4. In the left navigation bar, click **Download Software** to have Cisco WCS display the **Location Appliance > Transfer Software > <LocAppliance Name>** page.
5. Select the `Select from uploaded images to transfer into the Location Appliance` radio button, and use the drop-down menu to select the required location appliance application code (**ls-install-x-x-x-x.bin**, where **x-x-x-x** is the application code revision) from those already in the Windows Cisco WCS C:\Program Files\Cisco WCS30\webnms\ftp-server\root directory or the Linux Cisco WCS (to be determined) directory.

   -- OR --

   Select the `Browse a new software image to transfer into the Location Appliance` radio button, and use the drop-down menu to select the required location appliance application code (**ls-install-x-x-x-x.bin**, where **x-x-x-x** is the application code revision) from those already in an FTP server root directory.
6. Enter the number of seconds for a restore timeout between 1 and 999, default = 5 seconds. The Timeout generally does not need to be changed from the default.
7. Click **Download** to send the application code to the location appliance /opt/locserver/installers directory.

You have download application code from Cisco WCS or an external FTP server to a location appliance. Use the instructions in the Updating the location appliance Software Code Step in the Cisco 2700 Series Location Appliance Quick Start Guide to update the location appliance application code.

Defragmenting the Location Appliance Database

At any time, you can defragment the Cisco 2700 Series Location Appliance (location appliance) database:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. Select **Defragment Database**.
5. Click **OK** to defrag the location appliance database.

From the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can also change other parameters as described in *Editing Location Appliance Advanced Parameters*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Running Java GC on the Location Appliance Memory

At any time, you can run Java General Cleanup to free up Cisco 2700 Series Location Appliance (location appliance) memory:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. Select **Run Java GC**.

From the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page, you can also change other parameters as described in *Editing Location Appliance Advanced Parameters*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Restarting the Location Appliance Application Software

You can restart the Cisco 2700 Series Location Appliance (location appliance) application software at any time:

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the Location Appliance > General Properties > <LocAppliance Name> left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. In the Location Appliance > Advanced Parameters > <LocAppliance Name> page, select **Restart Server**.
5. Click **OK** to restart the location appliance application software. The reboot takes a few minutes to complete.

From the Location Appliance **> Advanced Parameters > <LocAppliance Name>** page, you can also change other parameters as described in *Editing Location Appliance Advanced Parameters*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Rebooting the Location Appliance

At any time, you can reboot the Cisco 2700 Series Location Appliance (location appliance):

1. In the Cisco WCS interface, select **LOCATE** to display the **All Location Appliances** page.
2. Click the desired Server Name to have Cisco WCS display the **Location Appliance > General Properties > <LocAppliance Name>** page.
3. In the Location Appliance > General Properties > <LocAppliance Name> left navigation bar, click **Advanced Parameters** to have Cisco WCS display the **Location Appliance > Advanced Parameters > <LocAppliance Name>** page.
4. In the Location Appliance > Advanced Parameters > <LocAppliance Name> page, select **Reboot Hardware**.
5. Click **OK** to reboot the location appliance. The reboot takes a few minutes to complete.

From the Location Appliance > Advanced Parameters > <LocAppliance Name> page, you can also change other parameters as described in *Editing Location Appliance Advanced Parameters*. Otherwise, continue with *Configuring Location Appliances* or *Operating the Location Appliances*.

Troubleshooting Tips

You can use the following sections to troubleshoot your Cisco WLAN Solution:

- *Using Error Messages*
- *Using Reason and Status Codes in the Trap Log*
- *Using Cisco 1000 Series Lightweight Access Point LEDs*

Using Error Messages

The Operating System may display any of the error messages described below.

Table - Error Messages and Descriptions

Error Message	Description
STATION_DISASSOCIATE	Client may have intentionally terminated usage or may have experienced a service disruption.
STATION_DEAUTHENTICATE	Client may have intentionally terminated usage or it could indicate an authentication issue.
STATION_AUTHENTICATION_FAIL	Check disable, key mismatch or other configuration issues.
STATION_ASSOCIATE_FAIL	Check load on the Cisco Radio or signal quality issues.
LRAD_ASSOCIATED	The associated Cisco 1000 Series lightweight access point is now managed by this Cisco Wireless LAN Controller.
LRAD_DISASSOCIATED	Cisco 1000 Series lightweight access point may have associated with a different Cisco Wireless LAN Controller or may have become completely unreachable.
LRAD_UP	Cisco 1000 Series lightweight access point is operational, no action required.
LRAD_DOWN	Cisco 1000 Series lightweight access point may have a problem or is administratively disabled.
LRADIF_UP	Cisco Radio is UP.
LRADIF_DOWN	Cisco Radio may have a problem or is administratively disabled.
LRADIF_LOAD_PROFILE_FAILED	Client density may have exceeded system capacity.
LRADIF_NOISE_PROFILE_FAILED	The non-802.11 noise has exceed configured threshold.
LRADIF_INTERFERENCE_PROFILE_FAILED	802.11 interference has exceeded threshold on channel -- check channel assignments.

Table - Error Messages and Descriptions (Continued)

Error Message	Description
LRADIF_COVERAGE_PROFILE_FAILED	Possible coverage hole detected - check Cisco 1000 Series lightweight access point history to see if common problem - add Cisco 1000 Series light-weight access points if necessary.
LRADIF_LOAD_PROFILE_PASSED	Load is now within threshold limits.
LRADIF_NOISE_PROFILE_PASSED	Detected noise is now less than threshold.
LRADIF_INTERFERENCE_PROFILE_PASSED	Detected interference is now less than threshold.
LRADIF_COVERAGE_PROFILE_PASSED	Number of clients receiving poor signal are within threshold.
LRADIF_CURRENT_TXPOWER_CHANGED	Informational message.
LRADIF_CURRENT_CHANNEL_CHANGED	Informational message.
LRADIF_RTS_THRESHOLD_CHANGED	Informational message.
LRADIF_ED_THRESHOLD_CHANGED	Informational message.
LRADIF_FRAGMENTATION_THRESHOLD_ CHANGED	Informational message.
RRM_DOT11_A_GROUPING_DONE	Informational message.
RRM_DOT11_B_GROUPING_DONE	Informational message.
ROGUE_AP_DETECTED	May be a security issue, use maps and trends to investigate.
ROGUE_AP_REMOVED	Detected rogue access point has timed out - May have shut down or moved out of coverage area.
AP_MAX_ROGUE_COUNT_EXCEEDED	The current number of active rogue access points has exceeded system threshold.
LINK_UP	Positive confirmation message.
LINK_DOWN	Port may have a problem or is administratively disabled.
LINK_FAILURE	Port may have a problem or is administratively disabled.
AUTHENTICATION_FAILURE	Attempted security breech - please investigate.
STP_NEWROOT	Informational message.
STP_TOPOLOGY_CHANGE	Informational message.
IPSEC_ESP_AUTH_FAILURE	Check WLAN IPSec configuration.
IPSEC_ESP_REPLAY_FAILURE	Check for attempt to spoof IP Address.

Table - Error Messages and Descriptions (Continued)

Error Message	Description
IPSEC_ESP_POLICY_FAILURE	Check for IPSec configuration mismatch between WLAN and client.
IPSEC_ESP_INVALID_SPI	Informational message.
IPSEC_OTHER_POLICY_FAILURE	Check for IPSec configuration mismatch between WLAN and client.
IPSEC_IKE_NEG_FAILURE	Check for IPSec IKE configuration mismatch between WLAN and client.
IPSEC_SUITE_NEG_FAILURE	Check for IPSec IKE configuration mismatch between WLAN and client.
IPSEC_INVALID_COOKIE	Informational message.
RADIOS_EXCEEDED	Maximum number of supported Cisco Radios exceeded - Check for Cisco Wireless LAN Controller failure in the same Layer 2 network or add another Cisco Wireless LAN Controller.
SENSED_TEMPERATURE_HIGH	Check fan, air conditioning and/or other cooling arrangements.
SENSED_TEMPERATURE_LOW	Check room temperature and/or other reasons for low temperature.
TEMPERATURE_SENSOR_FAILURE	Replace temperature sensor ASAP.
TEMPERATURE_SENSOR_CLEAR	Temperature sensor is operational.
POE_CONTROLLER_FAILURE	Check ports - possible serious failure detected.
MAX_ROGUE_COUNT_EXCEEDED	The current number of active rogue access points has exceeded system threshold.
SWITCH_UP	Cisco Wireless LAN Controller is responding to SNMP polls.
SWITCH_DOWN	Cisco Wireless LAN Controller is not responding to SNMP polls, check Cisco Wireless LAN Controller and SNMP settings.
RADIUS_SERVERS_FAILED	Check network connectivity between RADIUS and the Cisco Wireless LAN Controller.
CONFIG_SAVED	Running configuration has been saved to flash - will be active after reboot.
MULTIPLE_USERS	Another user with the same username has logged in.
FAN_FAILURE	Monitor Cisco Wireless LAN Controller temperature to avoid overheating.
POWER_SUPPLY_CHANGE	Check for power-supply malfunction.

Table - Error Messages and Descriptions (Continued)

Error Message	Description
COLD_START	Cisco Wireless LAN Controller may have been rebooted.
WARM_START	Cisco Wireless LAN Controller may have been rebooted.

Using Client Reason and Status Codes in the Trap Log

As described in Web User Interface Online Help, the Clients > Detail page lists the Reason and Status Codes you are likely to encounter when reviewing the Trap Logs. For your convenience the Reason and Status Codes and their descriptions are listed in the following sections:

- *Client Reason Codes*
- *Client Status Codes*

Client Reason Codes

The Client Reason code may be any of the following:

Table - Client Reason Code Descriptions and Meanings

Client Reason Code	Description	Meaning
0	noReasonCode	normal operation
1	unspecifiedReason	client associated but no longer authorized
2	previousAuthNotValid	client associated but not authorized
3	deauthenticationLeaving	the Cisco 1000 Series lightweight access point went offline, deauthenticating the client
4	disassociationDueToInactivity	client session timeout exceeded
5	disassociationAPBusy	the Cisco 1000 Series lightweight access point is busy, performing load balancing, for example
6	class2FrameFromNonAuthStation	client attempted to transfer data before it was authenticated
7	class2FrameFromNonAssStation	client attempted to transfer data before it was associated
8	disassociationStaHasLeft	Operating System moved the client to another Cisco 1000 Series lightweight access point using non-aggressive load balancing
9	staReqAssociationWithoutAuth	client not authorized yet, still attempting to associate with an Cisco 1000 Series lightweight access point
99	missingReasonCode	client momentarily in an unknown state

Client Status Codes

The Client Status code may be any of the following:

Table - Client Status Code Descriptions and Meanings

Client Status Code	Description	Meaning
0	idle	normal operation -- no rejections of client association requests
1	aaaPending	completing an aaa transaction
2	authenticated	802.11 authentication completed
3	associated	802.11 association completed
4	powersave	client in powersave mode
5	disassociated	802.11 disassociation completed
6	tobedeleted	to be deleted after disassociation
7	probing	client not associated or authorized yet
8	disabled	automatically disabled by Operating System for an operator-defined time

Using Cisco 1000 Series Lightweight Access Point LEDs

Table - Cisco 1000 Series Lightweight Access Point LED Conditions and Status

LED Conditions				Status
Power	Alarm	2.4 GHz	5 GHz	
Green ON	off	on or off	on or off	Cisco Wireless LAN Controller found, code OK, normal status.
Green ON	off	Yellow ON	on or off	802.11b/g Activity.
Green ON	off	on or off	Amber ON	802.11a Activity.
off	Red ON	off	off	Cisco 1000 Series lightweight access point starting up.
All LEDs cycle back and forth				Cisco 1000 Series lightweight access point searching for Cisco Wireless LAN Controller. Stops after Cisco Wireless LAN Controller and DHCP server found.
All LEDs blink on and off together				Cisco Wireless LAN Controller found, code upgrade in process.

Table - Cisco 1000 Series Lightweight Access Point LED Conditions and Status (Continued)

LED Conditions				Status
Power	**Alarm**	**2.4 GHz**	**5 GHz**	
off	Red FLASHING	off	off	Duplicate Cisco 1000 Series lightweight access point IP address.

REFERENCES

The following references are available:

- *Glossary*
- *Cisco WLAN Solution Supported Country Codes*
- Cisco WLAN Solution CLI Reference
- Web User Interface Online Help
- Cisco WCS User Interface Online Help
- Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Deployment Guide
- Internal-Antenna AP1010 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide
- External-Antenna AP1020 and AP1030 Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Quick Start Guide
- Cisco 1000 Series IEEE 802.11a/b/g Lightweight Access Point Ceiling-Mount Bezel Kit Quick Start Guide
- Cisco 2000 Series Wireless LAN Controller Quick Start Guide
- Cisco 2700 Series Location Appliance Quick Start Guide
- Cisco 4100 Series Wireless LAN Controller Quick Start Guide
- Cisco 4400 Series Wireless LAN Controller Quick Start Guide
- VPN/Enhanced Security Module Quick Start Guide
- 1000BASE-SX, 1000BASE-LX, and 1000BASE-T SFP Modules Quick Start Guide
- Cisco 4400 Series Power Supply Quick Start Guide
- Windows Cisco WCS Quick Start Guide
- Linux Cisco WCS Quick Start Guide
- Cisco Wireless LAN Controller and Cisco 1000 Series Lightweight Access Point Release Notes
- Cisco 2700 Series Location Appliance Release Notes
- Windows Cisco WCS Release Notes
- Linux Cisco WCS Release Notes
- *FCC Statements for Cisco 4100 Series Wireless LAN Controllers and Cisco 4400 Series Wireless LAN Controllers*
- *FCC Statements for Cisco 2000 Series Wireless LAN Controllers*
- *FCC Statements for Cisco 1000 Series Lightweight Access Points*
- *Legal Information*

Glossary

10BASE-T

An IEEE standard (802.3) for operating 10 Mbps Ethernet networks (LANs) with twisted pair cabling and wiring hubs.

100BASE-T

An IEEE standard (802.3) for operating 100 Mbps Ethernet networks (LANs) with twisted pair cabling and wiring hubs.

1000BASE-SX

An IEEE standard (802.3) for operating 1000 Mbps Ethernet networks (LANs) with fiber optic cables and wiring hubs. Also known as Gigabit Ethernet (GigE). Note that the Cisco WLAN Solution implementation uses small form-factor LC physical connectors for 1000BASE-SX connections.

1000BASE-T

An IEEE standard (802.3) for operating 1000 Mbps Ethernet networks (LANs) with twisted pair cabling and wiring hubs. Also known as Gigabit Ethernet (GigE).

802.11

802.11, or IEEE 802.11, is a type of radio technology used for wireless local area networks (WLANs). It is a standard that has been developed by the IEEE (Institute of Electrical and Electronic Engineers), http://standards.ieee.org. The IEEE is an international organization that develops standards for hundreds of electronic and electrical technologies. The organization uses a series of numbers, to differentiate between the various technology families.

The 802 LAN/MAN Standards Committee (of the IEEE) develops standards for local and metropolitan area networks with the 802.11 section creating standards for wireless local area networks.

802.11 is composed of several standards operating in different radio frequencies. 802.11b is a standard for wireless LANs operating in the 2.4 GHz spectrum with a bandwidth of 11 Mbps; 802.11g is a standard for wireless LANs operating in the 2.4 GHz spectrum with a bandwidth of 54 Mbps; 802.11a is a different standard for wireless LANs, and pertains to systems operating in the 5 GHz frequency range with a bandwidth of 54 Mbps. Another proposed standard, 802.11g, is for WLANs operating in the 2.4 GHz frequency but with a bandwidth of 54 Mbps.

802.11a

An IEEE specification for wireless networking that operates in the 5 GHz frequency range with a maximum 54 Mbps data transfer rate. The 5 GHz frequency band is not as crowded as the 2.4 GHz frequency, because the 802.11a specification offers more radio channels than the 802.11b/g. These additional channels can help avoid radio and microwave interference.

802.11b

International standard for wireless networking that operates in the 2.4 GHz frequency range (2.4 GHz to 2.4835 GHz) and provides a throughput of up to 11 Mbps. This is a very commonly used frequency. Microwave ovens, cordless phones, medical and scientific equipment, as well as Bluetooth devices, all work within the 2.4 GHz frequency band.

802.11g

Similar to 802.11b, but this proposed standard provides a throughput of up to 54 Mbps. It also operates in the 2.4 GHz frequency band but uses a different radio technology from 802.11b in order to increase bandwidth.

802.11i

A developing IEEE wireless LAN security standard. A subset of the 802.11i standard, WPA, is being deployed at this time.

802.1X

An IEEE authentication framework for 802.11 networks. Allows multiple authentication algorithms, including EAP and RADIUS.

Access Point

A wireless LAN transceiver or “base station” that can connect a wired LAN to one or many wireless devices. Some access points can also bridge to each other.

ACL

Access Control List. ACLs define what traffic types will be allowed or denied across one or more Interfaces. Each traffic type can be used in multiple ACLs, depending on up to 64 Rules defined for each ACL. If no ACL is applied to an Interface, all traffic types are allowed.

Ad-Hoc Mode

A client setting that provides independent peer-to-peer connectivity in a wireless LAN. An alternative set-up is one where PCs communicate with each other through an AP. See access point and Infrastructure mode.

AES

Advanced Encryption Standard. An encryption algorithm selected by the 802.11i task group to provide robust security in wireless networks.

Operating System

Operating System. Software that controls Cisco 4100 Series Wireless LAN Controllers and Cisco 1000 Series Lightweight Access Points. Includes Radio Resource Management (RRM) and Operating System Security functions.

Operating System Security

Part of the Operating System that controls all aspects of Security and roaming for the Cisco Wireless LAN Solution (Cisco WLAN Solution), providing seamless access to business-critical resources.

Radio Resource Management (RRM)

Part of the Operating System that continually monitors associated Cisco 1000 Series lightweight access points for Traffic Load, Interference, Noise, Coverage, and Nearby access points.

Using the collected information, the Radio Resource Management (RRM) dynamically reassigns channels, adjusts the transmit power to load balance coverage and capacity, allows the operator to group nearby Cisco 1000 Series lightweight access points, automatically detects and configures new Cisco 1000 Series lightweight access points, automatically detects and configures new Cisco Wireless LAN Controllers, and detects and reports coverage holes.

AP

See Access Point.

API

Application Programming Interface. The interface an application uses to call the operating system and other services. The API is usually defined at the source code level, and provides an interface between the application and the operating system.

Applet

An application or utility program that is designed to do a very specific and limited task.

Application Software

A computer program that is designed to do a general task. For example, word processing, payroll, Internet browsers and graphic design programs would all be considered applications.

Association

The process used by a client to connect to an Access Point.

Authentication

The process used to confirm a client's identity before communication is allowed with other devices connected to the Access Point.

Backbone

The central part of a large network that links two or more subnetworks and is the primary path for data transmission for a large business or corporation. A network can have a wired backbone or a wireless backbone.

Bandwidth

The amount of transmission capacity that is available on a network at any point in time. Available bandwidth depends on several variables such as the rate of data transmission speed between networked devices, network overhead, number of clients, and the type of device used to connect PCs to a network. It is similar to a pipeline in that capacity is determined by size: the wider the pipe, the more water can flow through it; the more bandwidth a network provides, the more data can flow through it. Standard 802.11b provides a bandwidth of 11 Mbps; Standards 802.11a and 802.11g provide a bandwidth of 54 Mbps. These are the raw capabilities of the network. Many things conspire to reduce these values, including protocol overhead, collisions, and implementation inefficiencies.

BIOS

Basic Input/Output System.

Bits per Second (bps)

A measure of data transmission speed over communication lines based on the number of bits that can be sent or received per second. Bits per second-bps-is often confused with bytes per second-Bps. 8 bits make a byte, so if a wireless network is operating at a bandwidth of 11 megabits per second (11 Mbps), it is sending data at 1.375 megabytes per second (1.375 Mbps).

Blacklist

Obsolete reference to the Exclusion List.

Bluetooth Wireless

A technology specification for linking portable computers, personal digital assistants (PDAs) and mobile phones for short-range transmission of voice and data across a global radio frequency band without the need for cables or wires. Bluetooth is a frequency-hopping technology in the 2.4 GHz frequency spectrum, with a range of 30 feet.

Bootloader

An operating system module (ppcboot) that loads software entities in a defined order to create a functional operating system.

Bridge

A product that connects a local area network (LAN) to another local area network that uses the same protocol (for example, wireless, Ethernet or token ring). Wireless bridges are commonly used to link buildings in campuses.

Broadband

A comparatively fast Internet connection. Services such as ISDN, cable modem, DSL and satellite are all considered broadband as compared to dial-up Internet access. There is no official speed definition of broadband but services of 100 Kbps and above are commonly thought of as broadband.

Bus Adapter

A special adapter card that installs in a PC's PCI or ISA slot and enables the use of PC Card radios in desktop computers. Some companies offer one-piece PCI or ISA Card radios that install directly into an open PC or ISA slot.

CA

Certification Authority. A trusted entity or person who issues public-key certificates for data encryption.

Cable Modem

A kind of converter used to connect a computer to a cable TV service that provides Internet access. Most cable modems have an Ethernet Out cable that attaches to a client's Wi-Fi gateway.

Cert.

Certificate. Used to authenticate the server and encrypt data transmissions between server and browser. See CA and ID Certificate.

Certification Authority

See CA.

Cipher

An algorithm used to encrypt data.

Client

Any computer or handheld device connected to a network that requests services (files, print capability) from another member of the network. Each client is associated with a unique MAC address.

Client Device

A Client is an wireless LAN end user. Wi-Fi client devices include PC Cards that slide into laptop computers, mini-PCI modules embedded in laptop computers and mobile computing devices, as well as USB radios and PCI/ISA bus Wi-Fi radios. Client devices usually communicate with hub devices like Access Points and Gateways.

Collision Avoidance

A network node characteristic for detecting traffic before transmitting so it can transmit a signal without risking a collision.

CPU

Central Processing Unit. The microprocessor part of a computer that interprets and executes instructions.

Crossover Cable

A special cable used for networking two computers without the use of a hub. Crossover cables may also be required for connecting a cable or DSL modem to a wireless gateway or access point. Instead of the signals transferring in parallel paths from one plug to another, the signals cross over.

For instance, in an eight-wire crossover cable, the signal starts on pin one at one end of the cable and ends up on pin eight at the other end. Similarly, the other wires cross over from pin two to pin seven, pin three to pin six, and pin four to pin five.

CSMA/CA

CSMA/CA is the principle medium access method employed by IEEE 802.11 WLANs. It is a "listen before talk" method of minimizing (but not eliminating) collisions caused by simultaneous transmission by multiple radios. IEEE 802.11 states collision avoidance method rather than collision detection must be used, because the standard employs half duplex radios-radios capable of transmission or reception-but not both simultaneously.

Unlike conventional wired Ethernet nodes, a WLAN station cannot detect a collision while transmitting. If a collision occurs, the transmitting station will not receive an ACKnowledge packet from the intended receive station. For this reason, ACK packets have a higher priority than all other network traffic. After completion of a data transmission, the receive station will begin transmission of the ACK packet before any other node can begin transmitting a new data packet. All other stations must wait a longer pseudo randomized period of time before transmitting. If an ACK packet is not received, the transmitting station will wait for a subsequent opportunity to retry transmission.

CSMA/CD

A method of managing traffic and reducing noise on an Ethernet network. A network device transmits data after detecting that a channel is available. However, if two devices transmit data simultaneously, the sending devices detect a collision and retransmit after a random time delay.

DC Power Supply

A module that converts AC power to DC. Depending on manufacturer and product, these modules can range from typical "wall wart" transformers that plug into a wall socket and provide DC power via a tiny plug to larger, enterprise-level Power over Ethernet (PoE) systems that inject DC power into the Ethernet cables connecting access points.

DES

Data Encryption Standard. A cryptographic algorithm used to protect data transmitted through an unsecured network.

DHCP

A utility that enables a server to dynamically assign IP Addresses from a predefined list and limit their time of use so that they can be reassigned. Without DHCP, an IT Manager would have to manually enter in all the IP Addresses of all the computers on the network. When DHCP is used, it automatically assigns an IP Address to each computing device as it logs onto the network.

Dialup

A communication connection via the standard telephone network, or Plain Old Telephone Service (POTS).

Digital Certificate

An electronic message used to verify a client's identity, and which can be used to encrypt data. Used in asymmetric public/private key encryption, in which public-key encrypted data can only be decrypted with the private key, and vice versa.

Disable

Obsolete reference to the Exclusion List.

Diversity Antenna

A type of antenna system that uses two antennas to maximize reception and transmission quality and reduce interference.

DMZ

Demilitarized Zone. A network layer added between the outside network (least secure) and internal network (most secure) in order to add an extra level of security protection. Many companies choose to locate Wireless Controllers, mail servers, Web servers, and remote access servers in the DMZ.

DNS

A program that translates URLs to IP Addresses by accessing a database maintained on a collection of Internet servers. The program works behind the scenes to facilitate surfing the Web with alpha versus numeric addresses. A DNS server converts a name like mywebsite.com to a series of numbers like 107.22.55.26. Every website has its own specific IP Address on the Internet.

DOS Attacks

Denial of Service Attacks. A network attack that creates enough congestion to block normal traffic.

DSCP

Differentiated Services Code Point. A packet header code from 0 - 63 that can be used to define quality of service across the Internet.

DSL

Various technology protocols for high-speed data, voice and video transmission over ordinary twisted-pair copper POTS (Plain Old Telephone Service) telephone wires.

DSSS

Direct Sequence Spread Spectrum. A carrier modulation technique used for 802.11b transmissions.

DTIM

Delivery Traffic Indication Map. A part of the TIM element in 802.11 beacons when a client has frames buffered in the AP for broadcasting or multicasting. The buffered frames are broadcasted or multicasted at each DTIM, when all power-saving clients expecting this data should be awake. See also TIM.

Dynamic Encryption Keys

Regularly-refreshed encryption keys. Used in LEAP and WPA protocols to decrease the ability to decrypt the encoded data.

EAP

Extensible Authentication Protocol. Used under 802.1X framework as a PPP extension to provide additional authentication options.

EIRP

Effective Isotropic Radiated Power. The equivalent transmitted signal power relative to a hypothetical isotropic (omnidirectional) radiator, measured in dBi (decibels isotropic).

Encryption

A method of scrambling data to maintain privacy.

Encryption Key

An alphanumeric (letters and/or numbers) series that enables data to be encrypted and then decrypted so it can be safely shared among members of a network. WEP uses an encryption key that automatically encrypts outgoing wireless data. On the receiving side, the same encryption key enables the computer to automatically decrypt the information so it can be read.

Enterprise

A term that is often applied to large corporations and businesses. The enterprise market can incorporate office buildings, manufacturing plants, warehouses and R&D facilities, as well as large colleges and universities.

ESSID

The identifying name of an 802.11 wireless network. When you specify your correct ESSID in your client setup you ensure that you connect to your wireless network rather than another network in range. (See SSID.) ESSID is also known as Network Name, Preferred Network, SSID or Wireless LAN Service Area.

Ethernet

International standard networking technology for wired implementations. Basic 10BASE-T networks offer a bandwidth of about 10 Mbps. Fast Ethernet (100 Mbps) and Gigabit Ethernet (1000 Mbps) are becoming popular.

Exclusion List

Clients who fail to authenticate three times when attempting to associate are automatically blocked, or Excluded, from further association attempts for an operator-defined timeout. After the Exclusion timeout, the client is allowed to retry authentication until it associates or fails authentication and is Exclusion again.

The Operating System also allows operators to permanently Exclude clients by MAC address.

Note that this feature was formerly known as Blacklisting and Disabling.

FCS

Frame Check Sequence. A cyclic redundancy check (CRC) Physical Layer 1 error-detection algorithm.

FIPS

Federal Information Processing Standard. Refer to FIPS Publication 197 (http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf) for more information.

Firewall

A system that enforces an access control policy between two or more networks, securing the network(s) and preventing access by unauthorized users. Firewalls can be software, hardware or a combination of both. Firewalls can prevent unrestricted access into a network, as well as restrict data from flowing out of a network.

FireWire

A high-speed serial bus system, FireWire is the IEEE 1394 standard for input/output technology that connects multimedia and storage peripherals to a PC. FireWire (Apple), 1394 (Linux) and iLink (Sony) are different names for products that perform the same function. FireWire can provide a bandwidth of about 400 Mbps.

.FPE

A filename extension used by the Floor Plan Editor for wall map configuration files. Requires a corresponding .GIF, .JPG, .BMP, or .PNG file when importing into Cisco WCS.

GARP

General Attribute Registration Protocol.

Gateway

In the wireless world, a gateway is an access point with additional software capabilities such as providing NAT and DHCP. Gateways may also provide VPN support, roaming, firewalls, various levels of security, etc.

GigE

A Gigabit Ethernet IEEE standard (802.3) for operating 1000 Mbps Ethernet networks (LANs) with fiber optic cables and wiring hubs. See also 1000BASE-SX.

GUI

Graphical User Interface. A computer user interface based on graphics rather than text; uses a mouse or other input device as well as a keyboard.

GVRP

GARP VLAN Registration Protocol.

HotSpot

A place where you can access Wi-Fi service. This can be for free or for a fee. HotSpots can be inside a coffee shop, airport lounge, train station, convention center, hotel or any other public meeting area. Corporations and campuses are also implementing HotSpots to provide wireless Internet access to their visitors and guests. In some parts of the world, HotSpots are known as CoolSpots.

Hub

A multiport device used to connect PCs to a network via Ethernet cabling or via wireless connections. Wired hubs can have numerous ports and can transmit data at speeds ranging from 10 Mbps to multig-igabyte speeds per second. A hub transmits packets it receives to all the connected ports. A small wired hub may only connect 4 computers; a large hub can connect 48 or more. Wireless hubs can connect hundreds.

Hz

The international unit for measuring frequency, equivalent to the older unit of cycles per second. One megahertz (MHz) is one million hertz. One gigahertz (GHz) is one billion hertz. The standard US electrical power frequency is 60 Hz, the AM broadcast radio frequency band is 535-1605 kHz, the FM broadcast radio frequency band is 88-108 MHz, and wireless 802.11b/g LANs operate at 2.4 GHz.

I/O

The term used to describe any operation, program or device that transfers data to or from a computer.

ID Certificate

A Certificate used by Web server operators to ensure secure server operation. Usually accompanied by a Private Key.

IEEE

Institute of Electrical and Electronics Engineers, New York, www.ieee.org. A membership organization that includes engineers, scientists and students in electronics and allied fields. It has more than 300,000 members and is involved with setting standards for computers and communications.

IEEE 802.11

A set of specifications for LANs from The Institute of Electrical and Electronics Engineers (IEEE). Most wired networks conform to 802.3, the specification for CSMA/CD based Ethernet networks or 802.5, the specification for token ring networks. 802.11 defines the standard for wireless LANs encompassing three incompatible (non-interoperable) technologies: Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS) and Infrared. See also 802.11, 802.11a, 802.11b, 802.11g and 802.1X. See also WECA.

IKE

Internet Key Exchange. A protocol used to start, stop and monitor IPSec dynamic tunnels.

iLink

Sony's term for IEEE1394 technology that provides a bandwidth of about 400 Mbps. Many people also refer to this high-speed communication technology using Apple's original term, FireWire. Future versions of 1394 will greatly increase the bandwidth.

Infrastructure Mode

A client setting providing connectivity to an AP. As compared to Ad-Hoc mode, whereby PCs communicate directly with each other, clients set in Infrastructure Mode all pass data through a central AP. The AP not only mediates wireless network traffic in the immediate neighborhood, but also provides communication with the wired network. See Ad-Hoc and AP.

Internet Appliance

A computer that is intended primarily for Internet access, is simple to set up and usually does not support installation of third-party software. These computers generally offer customized web browsing, touch-screen navigation, email services, entertainment and personal information management applications. An Internet appliance can be Wi-Fi enabled or it can be connected via a cable to the local network.

IP

Internet Protocol. A set of rules used to send and receive messages at the Internet address level.

IP Address

A 32-bit number that identifies each sender or receiver of information that is sent across the Internet. An IP Address has two parts: an identifier of a particular network on the Internet and an identifier of the particular device (which can be a server or a workstation) within that network.

IP Telephony

Internet Protocol Technology that supports voice, data and video transmission via IP-based LANs, WANs, and the Internet. This includes VoIP (Voice over IP).

IPSec

IP Security. Protocol used to authenticate and/or encrypt IP data using IPSec and/or IKE secure tunnels. Used to support VPN tunnels across the internet.

IPSec Passthrough

Operating System Security feature that allows IPSec-equipped clients to communicate directly with other IPSec equipment.

IPX-SPX

IPX, short for Internetwork Packet Exchange, a networking protocol used by the Novell NetWare operating systems. Like UDP/IP, IPX is a datagram protocol used for connectionless communications.

Higher-level protocols, such as SPX and NCP, are used for additional error recovery services. Sequenced Packet Exchange, SPX, a transport layer protocol (layer 4 of the OSI Model) used in Novell Netware networks. The SPX layer sits on top of the IPX layer (layer 3) and provides connection-oriented services between two nodes on the network. SPX is used primarily by client/server applications. Whereas the IPX protocol is similar to IP, SPX is similar to TCP. Together, therefore, IPX-SPX provides connection services similar to TCP/IP.

ISA

A type of internal computer bus that allows the addition of card-based components like modems and network adapters. ISA has been replaced by PCI and is not very common anymore.

ISDN

A type of broadband Internet connection that provides digital service from the customer's premises to the dial-up telephone network. ISDN uses standard POTS copper wiring to deliver voice, data or video.

ISO Network Model

A network model developed by the International Standards Organization (ISO) that consists of seven different levels, or layers. By standardizing these layers, and the interfaces in between, different portions of a given protocol can be modified or changed as technologies advance or systems requirements are altered. The seven layers are:

- Application, Layer 7
- Presentation, Layer 6
- Session, Layer 5
- Transport, Layer 4
- Network, Layer 3
- Data Link, Layer 2
- Physical, Layer 1

The IEEE 802.11 Standard encompasses the physical layer (PHY) and the lower portion of the data link layer. The lower portion of the data link layer is often referred to as the Medium Access Controller (MAC) sublayer.

ISS

A special software application that allows all PCs on a network access to the Internet simultaneously through a single connection and Internet Service Provider (ISP) account.

Key Management

Ensuring that encryption keys are current and synchronized between clients and Access Points. Key management can be performed manually or automatically using 802.1X.

L2TP

Layer 2 Tunneling Protocol, a PPP protocol extension enabling providers to operate Virtual Private Networks (VPNs).

LAN

A system of connecting PCs and other devices within close physical proximity for sharing resources such as an Internet connections, printers, files and drives. When Wi-Fi is used to connect the devices, the system is known as a wireless LAN or WLAN.

LEAP

Cisco Wireless EAP. EAP used by Cisco equipment to secure wireless networks with WEP-based devices.

LWAPP

The pending IETF (Internet Engineering Task Force) Lightweight Access Point Protocol standard defining communications between Wireless LAN Controllers and “Light” Access Points.

MAC

Medium Access Control. This is the function of a network controller that determines who gets to transmit when. Each network adapter must be uniquely identified. Every wireless 802.11 device has its own specific MAC address hard-coded into it. This unique identifier can be used to provide security for wireless networks. When a network uses a MAC table, only the 802.11 radios that have had their MAC addresses added to that network's MAC table will be able to get onto the network.

Mapping

Assigning a PC to a shared drive or printer port on a network.

MIC

Message Integrity Check. Used to ensure the integrity of a received message.

Mobile Device

See Client, Client Device.

Mobile Professional

A salesperson or a “road warrior” who travels frequently and requires the ability to regularly access his or her corporate networks, via the Internet, to post and retrieve files and data and to send and receive email.

NAT

A network capability that enables a houseful of computers to dynamically share a single incoming IP Address from a dial-up, cable or xDSL connection. NAT takes the single incoming IP Address and creates new IP Address for each client computer on the network.

NetBIOS

Network Basic Input/Output System. An API, or set of network commands, which activates network data transfer operations between IBM PC compatibles.

Network Name

Identifies the wireless network for all the shared components. During the installation process for most wireless networks, you need to enter the network name or SSID. Different network names are used when setting up your individual computer, wired network or workgroup.

NIC

A type of PC adapter card that either works without wires (Wi-Fi) or attaches to a network cable to provide two-way communication between the computer and network devices such as a hub or switch. Most office wired NICs operate at 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet) or 10/100 Mbps dual speed. High-speed Gigabit and 10 Gigabit NIC cards are also available. See PC Card.

NOC

Network Operations Center. A location from which large communications networks are planned, monitored, and administered.

NVRAM

Non-Volatile Random Access Memory. Any type of memory that does not lose its contents when the main power is removed. (See also Volatile RAM.)

OFDM

Orthogonal Frequency Division Multiplexing. A multi-carrier modulation technique used for 802.11a and 802.11g transmissions.

PC Card

A removable, credit-card-sized memory or I/O device that fits into a Type 2 PCMCIA standard slot, PC Cards are used primarily in PCs, portable computers, PDAs and laptops. PC Card peripherals include Wi-Fi cards, memory cards, modems, NICs, hard drives, etc.

PCI

A high-performance I/O computer bus used internally on most computers. Other bus types include ISA and AGP. PCIs and other computer buses enable the addition of internal cards that provide services and features not supported by the motherboard or other connectors.

PCMCIA

Expansion cards now referred to as “PC Cards” were originally called “PCMCIA Cards” because they met the standards created by the Personal Computer Memory Card International Association.

PDA

Smaller than laptop computers but with many of the same computing and communication capabilities, PDAs range greatly in size, complexity and functionality. PDAs can provide wireless connectivity via embedded Wi-Fi Card radios, slide-in PC Card radios, or Compact Flash Wi-Fi radios.

Peer-to-Peer Network

A wireless or wired computer network that has no server or central hub or router. All the networked PCs are equally able to act as a network server or client, and each client computer can talk to all the other wireless computers without having to go through an access point or hub. However, since there is no central base station to monitor traffic or provide Internet access, the various signals can collide with each other, reducing overall performance.

PEM

Privacy Enhanced Mail. PEM files are created from CSR files by a Certification Authority (CA) using base64 encoding with additional header and footer lines.

PHY

The lowest layer within the OSI Network Model. It deals primarily with transmission of the raw bit stream over the PHYsical transport medium. In the case of wireless LANs, the transport medium is free space. The PHY defines parameters such as data rates, modulation method, signaling parameters, transmitter/receiver synchronization, etc. Within an actual radio implementation, the PHY corresponds to the radio front end and baseband signal processing sections.

Plug and Play

A computer system feature that automatic configures of add-ons and peripheral devices such as wireless PC Cards, printers, scanners and multimedia devices.

POTS

Plain Old Telephone Service. Wired analog telephone service.

ppcboot

Cisco Wireless LAN Controller Bootloader.

PPP

Point-to-Point Protocol.

Proxy Server

Used in larger companies and organizations to improve network operations and security, a proxy server is able to prevent direct communication between two or more networks. The proxy server forwards allowable data requests to remote servers and/or responds to data requests directly from stored remote server data.

QoS

Quality of Service. A term that guarantees a specific throughput level. For instance, high QoS can be used to ensure adequate throughput for Voice over WLAN.

Range

How far will your wireless network stretch? Most Wi-Fi systems will provide a range of a hundred feet or more. Depending on the environment and the type of antenna used, Wi-Fi signals can have a range of up to mile.

RADIUS

Remote Authentication Dial-In User Service. An authentication and accounting system used to exclude unauthorized clients.

Residential Gateway

A wireless device that connects multiple PCs, peripherals and the Internet on a home network. Most Wi-Fi residential gateways provide DHCP and NAT as well.

RF

Radio Frequency. A frequency within which radio waves may be transmitted.

RJ-45

Standard connectors used in Ethernet networks. Even though they look very similar to standard RJ-11 telephone connectors, RJ-45 connectors can have up to eight wires, whereas telephone connectors have only four.

Roaming

Moving seamlessly from one AP coverage area to another with no loss in connectivity.

Router

A device that forwards data packets from one local area network (LAN) or wide area network (WAN) to another. Based on routing tables and routing protocols, routers can read the network address in each transmitted frame and make a decision on how to send it via the most efficient route based on traffic load, line costs, speed, bad connections, etc.

RSN

Robust Security Network. An IEEE 802.11i working group strong authentication and encryption standard that uses 802.1X, EAP, AES, TKIP, and MIC.

RSSI

Received Signal Strength Indicator, also known as Signal Strength. A measure of received RF energy, measured in dBm.

RTOS

Real-time operating system. An operating system that features a guaranteed performance per time unit.

Rx

Receive.

Satellite Broadband

A wireless high-speed Internet connection provided by satellites. Some satellite broadband connections are two-way-up and down. Others are one-way, with the satellite providing a high-speed downlink and then using a dial-up telephone connection or other land-based system for the uplink to the Internet.

Server

A computer that provides its resources to other computers and devices on a network. These include print servers, Internet servers and data servers. A server can also be combined with a hub or router.

Site Survey

The process whereby a wireless network installer inspects a location prior to putting in a wireless network. Site surveys are used to identify the radio- and client-use properties of a facility so that access points can be optimally placed.

SNR

Signal to Noise Ratio. The ratio of signal intensity to noise intensity, measured in dB.

SOHO

A term generally used to describe an office or business with ten or fewer computers and/or employees.

SSH

Secure Shell; also known as Secure Socket Shell. SSH data transmissions and passwords to and from Cisco 4100 Series Wireless LAN Controller are encrypted and use digital certificates for authentication from both ends of the connection. SSH is always enabled for Cisco Wireless LAN Controllers.

When you plan to secure the Cisco Wireless LAN Controller Telnet Interface using the SSH protocol, note that the Operating System automatically generates its own local SSH certificate and automatically applies it to the Telnet Interface.

SSID

A 32-character unique identifier attached to the header of packets sent over a WLAN that acts as a name when a mobile device tries to connect to an access point. (Also called ESSID.) The SSID differentiates one WLAN from another, so all access points and all devices attempting to connect to a specific WLAN must use the same SSID. A device will not be permitted to associate with the AP unless it can provide the unique SSID. Because an SSID can be sniffed in plain text from a packet, it does not supply any security to the network. An SSID is also referred to as a Network Name because essentially it is a name that identifies a wireless network.

SSL

Secure Sockets Layer. Commonly used encryption protocol used by many enterprises to protect the security and integrity of transactions. When an SSL session begins, the server sends its public key to the browser. The browser then sends a randomly generated secret key back to the server to complete a secret key exchange for that session.

When you plan to secure the Cisco Wireless LAN Controller HTTP: Web User Interface using the https: (HTTP + SSL) protocol, note that the Operating System automatically generates its own local Web Administration SSL certificate and automatically applies it to the Web User Interface.

Static Key

An encryption key that has been entered into both access point and client, used for encrypting data communications. Static WEP keys can be cracked, but AES keys are currently safe for wireless transmissions.

Subnetwork or Subnet

Found in larger networks, these smaller networks are used to simplify addressing between numerous computers. Subnets connect to the central network through a router, hub or gateway. Each individual wireless LAN will probably use the same subnet for all the local computers it talks to.

Subscriber

A subscriber is the user who accesses network services through an 802.11 client.

Switch

A type of hub that efficiently controls the way multiple devices use the same network so that each can operate at optimal performance. A switch acts as a network traffic policeman: rather than transmitting all the packets it receives to all ports as a hub does, a switch transmits packets to only the receiving port.

TCP

A protocol used along with the Internet Protocol (IP) to send data in the form of individual units (called packets) between computers over the Internet. While IP takes care of handling the actual delivery of the data, TCP takes care of keeping track of the packets that a message is divided into for efficient routing through the Internet. For example, when a web page is downloaded from a web server, the TCP program layer in that server divides the file into packets, numbers the packets, and then forwards them individually to the IP program layer. Although each packet has the same destination IP Address, it may get routed differently through the network. At the other end, TCP reassembles the individual packets and waits until they have all arrived to forward them as a single file.

TCP/IP

The underlying technology behind the Internet and communications between computers in a network. The first part, TCP, is the transport part, which matches the size of the messages on either end and guarantees that the correct message has been received. The IP part is the client's computer address on a network. Every computer in a TCP/IP network has its own IP Address that is either dynamically assigned at startup or permanently assigned. All TCP/IP messages contain the address of the destination network as well as the address of the destination station. This enables TCP/IP messages to be transmitted to multiple networks (subnets) within an organization or worldwide.

TFTP

Trivial File Transfer Protocol.

TIM

Traffic Indication Map. An element in all 802.11 beacons when a client has frames buffered in the AP. The buffered frames are broadcasted or multicasted at each DTIM, when all power-saving clients expecting this data should be awake. See also DTIM.

TKIP

Temporal Key Integrity Protocol. Generates new keys every 10 kb of payload traffic.

Tx

Transmit.

USB

A high-speed bidirectional serial connection between a PC and a peripheral that transmits data at the rate of 12 megabits per second. The new USB 2.0 specification provides a data rate of up to 480 Mbps, compared to standard USB at only 12 Mbps. 1394, FireWire and iLink all provide a bandwidth of up to 400 Mbps.

VLAN

Virtual LAN. A networking mechanism that makes clients appear as if they are connected to the same network, even if they are physically located on different LAN segments. Cisco WLAN Solution recommends that you assign one set of VLANs for WLANs and a different set of VLANs for mobility groups to ensure that Cisco Wireless LAN Controllers properly route VLAN traffic.

VoIP

Voice transmission using Internet Protocol to create digital packets distributed over the Internet. VoIP can be less expensive than voice transmission using standard analog packets over POTS (Plain Old Telephone Service).

Volatile RAM

Volatile Random Access Memory. The basic form of computer memory, which can be accessed randomly. In the Cisco WLAN Solution products, the Volatile RAM contains the active settings for current operations. Upon reboot, the Volatile RAM is cleared, and the configurations stored in the NVRAM are copied into the Volatile RAM. (See also NVRAM.)

VPN

A type of technology designed to increase the security of information transferred over the Internet. VPN can work with either wired or wireless networks, as well as with dial-up connections over POTS. VPN creates a private encrypted tunnel from the end user's computer, through the local wireless network, through the Internet, all the way to the corporate servers and database.

WAN

A communication system of connecting PCs and other computing devices across a large local, regional, national or international geographic area. Also used to distinguish between phone-based data networks and Wi-Fi. Telephone networks are considered WANs and Wi-Fi networks are considered Wireless Local Area Networks (WLANs).

War Chalking

Marking symbols on sidewalks and walls to indicate nearby access points. This allows other 802.11-equipped clients to connect to the Internet using other peoples' access points. This practice was inspired by hobos during the Great Depression who used chalk marks to indicate friendly homes.

WebAuth

Web Authentication. An application-layer authentication of a user by username and password contained in either a local or RADIUS database.

WECA

Wireless Ethernet Compatibility Alliance, the former name of the Wi-Fi Alliance.

WEP

Wired Equivalent Privacy. Basic wireless security provided by Wi-Fi. In some instances, WEP may be all a home or small-business user needs to protect wireless data. Cisco WLAN Solution equipment supports the following WEP versions:

- 40-bit, also called 64-bit encryption.
- 108-bit, also called 128-bit encryption.
- 128-bit, also called 152-bit encryption.

Wi-Fi Alliance

An organization of wireless equipment and software providers, formerly known as the Wireless Ethernet Compatibility Alliance (WECA), organized to certify 802.11-based products for interoperability and to promote Wi-Fi as the universal brand name for 802.11-based wireless LAN products.

While all 802.11a/b/g products are called Wi-Fi, only products that have passed the Wi-Fi Alliance testing are allowed to refer to their products as 'Wi-Fi Certified'. Currently, all Cisco 1000 Series Light-weight Access Points have 802.11a and 802.11b Wi-Fi certification.

WISP

Wireless Internet Service Provider.

WLAN

Also referred to as Wireless LAN. A type of local-area network that uses high-frequency radio waves rather than wires to communicate between nodes.

WME

Microsoft Wireless Multimedia Extensions, which is a precursor to 802.11e QoS standard.

WPA

Wi-Fi Protected Access. A subset of the IEEE 802.11i wireless LAN security/encryption standard. Uses TKIP. Currently supported by the Cisco Wireless LAN Controller.

VG

Virtual Gateway. A virtual (unassigned, reserved) IP address, such as 1.1.1.1, used by Cisco WLAN Solution Layer 3 Security and Mobility managers.

XAuth

Extended Authentication. A client authentication protocol used with other protocols, such as IKE.

Cisco WLAN Solution Supported Country Codes

The Cisco WLAN Solution has been approved or is being approved to operate in the following countries, and fully conforms with current country requirements. Note that some of these entries may change over time; consult www.cisco.com/go/aironet/compliance for current approvals and Regulatory Domain information.

Note that the maximum regulatory Transmit Power Level Limits published here are defined by the Country Code setting, and are regulated on a country by country basis. Also note that the actual maximum transmit power levels may be less than the published regulatory limits.

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
AT/ Austria	-E	a	36, 40, 44, 48	60 mW EIRP	In	5.15-5.25	BMV/ FSB-LD047
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
AU/ Australia	-N	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.725-5.825	ACA
		b	1 - 11	200 mW EIRP	Both	2.4-2.4835	
BE/ Belgium	-E	a	36, 40, 44, 48 52, 56, 60, 64	120 mW EIRP 120 mW EIRP	In In	5.15-5.25	BIPT/ Annexe B3 Interface radio HIP-ERLAN
		b/g	1 - 12 13	100 mW EIRP 100 mW EIRP	In Out	2.4-2.4835	
BR/ Brazil	-C	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	200 mW EIRP 1 W EIRP	In Both	5.725-5.85	Anatel/ Resolution 305
		b/g	1 - 11	1 W EIRP	Both	2.4-2.4835	
CA/ Canada	-A	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	Industry Canada RSS-210
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
CH/ Switzer-land and Liechten-stein	-E	a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP 200 mW EIRP	In In	5.15-5.25 5.25-5.35	OFCOM
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
CY/ Cyprus	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	(tbd)
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
CZ/ Czech Republic	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.725-5.825	CTO
		b	1 - 11	200 mW EIRP	Both	2.4-2.4835	
DE/ Germany	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	RegTP/ wlan35
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
DK/ Denmark	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	ITST/ Radio inter-face specifi-cation 00 007
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
EE/ Estonia	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	SIDEAMET
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
ES/ Spain	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	Ministry of Telecom-munica-tions
		b/g	1 - 11	100 mW EIRP	In	2.412-2.472	
FI/ Finland	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	FICORA/ RLAN Notice
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
FR/ France	-E	a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP 200 mW EIRP	In In	5.15-5.25 5.25-5.35	A.R.T./ Decision 01-441
		b/g	1 - 7 8 - 11	100 mW EIRP 100 mW EIRP	Both In	2.4-2.4835 2.4-2.454	
GB/ United Kingdom	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	UKRA/ IR2006
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
GR/ Greece	-E	b/g	1 - 11	100 mW EIRP	In	2.4-2.4835	Ministry of Transport & Communi-cations
HK/ Hong Kong	-N	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	200 mW EIRP 200 mW EIRP 1 W+6 dBi=4 W	Both Both Both	5.15-5.25 5.25-5.35 5.725-5.85	OFTA
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
HU/ Hungary	-E	a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP	In	5.15-5.25 5.25-5.35	HIF
		b/g	1 - 11	1 W EIRP	Both	2.4-2.4835	
IE/ Ireland	-E	a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	COMREG/ ODTR 00/ 61, ODTR 0062
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
IL/ Israel	-I	a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP 200 mW EIRP	In In	5.15-5.25 5.25-5.35	MOC
		b/g	1 - 13	100 mW EIRP	Both	2.4-2.4835	
ILO/ Israel OUTDOOR		a	36, 40, 44, 48 52, 56, 60, 64	200 mW EIRP 200 mW EIRP	In In	5.15-5.25 5.25-5.35	MOC
		b/g	5 - 13	100 mW EIRP	Both	2.4-2.4835	
IN/ India	(TBD)	a	N/A	N/A	N/A	N/A	WPC
		b/g		4 W EIRP	In	2.4-2.4835	
IS/ Iceland	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	PTA
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
IT/ Italy	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	Ministry of Comm
		b/g	1 - 11	100 mW EIRP	In	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
JP/ Japan	-J	a	1-3 1-4	100 mW EIRP 100 mW EIRP	Both In	5.03-5.09 5.15-5.25	Telec/ARIB STD-T66
		b	1-14	10 mW/MHz~200mW EIRP	Both	2.4-2.497	
		g	1-13	10 mW/MHz~200mW EIRP	Both	2.4-2.497	
KR/ Republic of Korea	-C	a	149, 153, 157, 161	150 mW+6 dBi~600 mW	Both	5.725-5.825	RRL/ MIC Notice 2003-13
		b/g	1-13	150 mW+6 dBi~600 mW	Both	2.4-2.4835	
LT/ Lithuania	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	LTR
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
LU/ Luxem-bourg	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	ILR
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
LV/ Latvia	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	(tbd)
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
MY/ Malaysia	-E	b/g	1-13	100 mW EIRP	In	2.4-2.5	CMC
NL/ Nether-lands	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	Radiocom Agency
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
NO/ Norway	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	NPT
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
NZ/ New Zealand	-N	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	RSM
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
PH/ Philippines	-C	a	(tbd)	(tbd)	(tbd)	5.725-5.875	PDC
		b	(tbd)	100 mW EIRP	(tbd)	2.4-2.4835	
PL/ Poland	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	200 mW EIRP 1 W EIRP	In Both	2.4-2.4835	Office of Telecom & Post
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
PT/ Portugal	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	NCA
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	
SE/ Sweden	-E	a	36, 40, 44, 48 52, 56, 60, 64 104, 108, 112, 116, 120, 124, 128, 132, 140	200 mW EIRP 200 mW EIRP 1 W EIRP	In In Both	5.15-5.25 5.25-5.35 5.47-5.725	PTS
		b/g	1 - 11	100 mW EIRP	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
SG/ Singapore	-S	a	36, 40, 44, 48, 52, 56, 60, 64, 149, 153, 157, 161	200 mW EIRP 200 mW EIRP 1 W EIRP	Both Both Both	5.15-5.25 5.25-5.35 5.725-5.85	IDA/ TS SSS Issue 1
		b/g	1 - 13	200 mW EIRP	Both	2.4-2.4835	
SI/ Slovenia	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	ATRP
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
SK/ Slovak Republic	-E	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	Telecom Admin.
		b/g	1 - 11	1 W+Restricted Antennas	Both	2.4-2.4835	
TH/ Thailand	(TBD)	a	N/A	N/A	N/A	5.725-5.875	PDT
		b/g	1-13	100 mW EIRP	In	2.4-2.5	
TW/ Taiwan	-T	a	56, 60, 64, 100 - 140 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both	5.25-5.35 5.47-5.725 5.725-5.825	PDT
		b/g	1-13	1 W EIRP	Both	2.4-2.4835	
US/ United States of America	-A	a	36, 40, 44, 48 52, 56, 60, 64 149, 153, 157, 161	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W 1 W+6 dBi=4 W	In Both Both	5.15-5.25 5.25-5.35 5.725-5.85	FCC Part 15
		b/g	1 - 11	1 W Conducted Output	Both	2.4-2.4835	
USE/ United States of America	-A	a	36, 40, 44, 48 52, 56, 60, 64	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W	In Both	5.15-5.25 5.25-5.35	FCC Part 15
		b/g	1 - 11	1 W Conducted Output	Both	2.4-2.4835	
USL/ United States of America LOW	-A	a	36, 40, 44, 48 52, 56, 60, 64	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W	In Both	5.15-5.25 5.25-5.35	FCC Part 15
		b/g	1 - 11	1 W Conducted Output	Both	2.4-2.4835	

Country Code / Country	Cisco 1000 Series Lightweight Access Point Regulatory Domain	802.11 Bands	Channels Allowed	Maximum Transmit Power (RadioTx + Antenna Gain = EIRP)	Indoor / Outdoor Use	Frequency Range (GHz)	Regulatory Authority
USX/ United States of America EXTENDED	(TBD)	a	36, 40, 44, 48 52, 56, 60, 64	50 mW+6 dBi=200 mW 250 mW+6 dBi=1 W	In Both	5.15-5.25 5.25-5.35	FCC Part 15
		b/g	1 - 11	1 W Conducted Output	Both	2.4-2.4835	
ZA/ South Africa	(TBD)	a	N/A	N/A	N/A	5.25-5.35 5.725-5.825	(tbd)
		b/g	1-13	1 W EIRP	Both	2.4-2.4835	